

**HERBERT HOOVER DIKE
MAJOR REHABILITATION EVALUATION REPORT
REACH ONE**

**SUPPLEMENTAL DRAFT
ENVIRONMENTAL IMPACT STATEMENT**

SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT

The Herbert Hoover Dike Major Rehabilitation Evaluation Report

Proposed Action: Five alternatives are proposed to reduce the probability of a breach of Reach One of the Herbert Hoover Dike that surrounds Lake Okeechobee, in Martin and Palm Beach Counties, Florida.

Type of Statement: Supplemental Draft Environmental Impact Statement

Lead Agency: U.S. Army Corps of Engineers

Abstract

The Herbert Hoover Dike (HHD) built around Lake Okeechobee in south central Florida was originally constructed as a series of embankments by local interests in 1915 in order to provide flood protection to the surrounding communities and controlled irrigation for local agriculturists. These embankments were improved to the current levee system by the U.S. Army Corps of Engineers (Corps) during the 1930s and 1940s, and major culvert modifications were accomplished in the 1970s. Since then, only as-needed repairs have been made to the HHD. Recent high water events have caused several boils and pipings around the dike, suggesting the need for major rehabilitation. The Corps is preparing a series of HHD Major Rehabilitation Evaluation Reports (MRR) which document seepage and stability concerns along the HHD system and provide rehabilitation options. The initial MRR and this EIS focuses on Reach One, the southeastern portion of the HHD, and proposes five alternative actions for rehabilitation. The alternatives include (a) no action, which is defined as not making improvements to Reach One, and would cause no physical changes in the study area, (b) construction of a stability berm at the landside toe of the levee and installing culverts with automatic/manual gates and pumps to control the water level in the ditches, (c) construction of an upstream impervious cutoff wall and a landside stability berm at the toe of the levee which would impede groundwater flow and control underseepage, (d) a Seepage Toe Berm with relief trench at the dike toe and (e) the Preferred Alternative, which includes a pervious cutoff wall and a relief trench on the landward slope of the dike and within the HHD's existing footprint. A Supplemental Draft Environmental Impact Statement (SDEIS) has been prepared to examine the effects of the proposed actions. Based on the analysis of the SDEIS, construction of the selected alternative would cause short-term disturbance to and displacement of components of the human and natural environments. The MRR and Supplemental MRR propose remedial measures that would improve slope stability and seepage control and reduce the probability of a breach of Reach One of the HHD.

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Herbert Hoover Dike - Reach 1 Supplemental Major Rehabilitation Evaluation Report

Introduction

For over 20 years, USACE reports have documented numerous cases of seepage, piping, boils, and stability problems along several sections of the Herbert Hoover Dike (HHD) surrounding Lake Okeechobee. These embankment distresses are exacerbated during high water events that correspond roughly to a 30-year recurrence interval, or when the lake elevation approaches 18.5 feet NGVD.

In November 2000, USACE published a Major Rehabilitation Evaluation Report (MRR) for Reach 1 of the HHD, as authorized by HQUSACE in accordance with ER 1130-2-417 (now superseded by 1130-2-500). In order to prioritize stability concerns, the HHD was divided into 8 Reaches as shown in Figure 1. Reach 1 was given the highest priority and Reach 8 the lowest. Due to concerns over being able to fully fund such a large repair project, construction schedule limitations, and variations in geology, Reach 1 was further subdivided into 4 subreaches; beginning with A in the northernmost stretch and ending with D in the southernmost stretch.

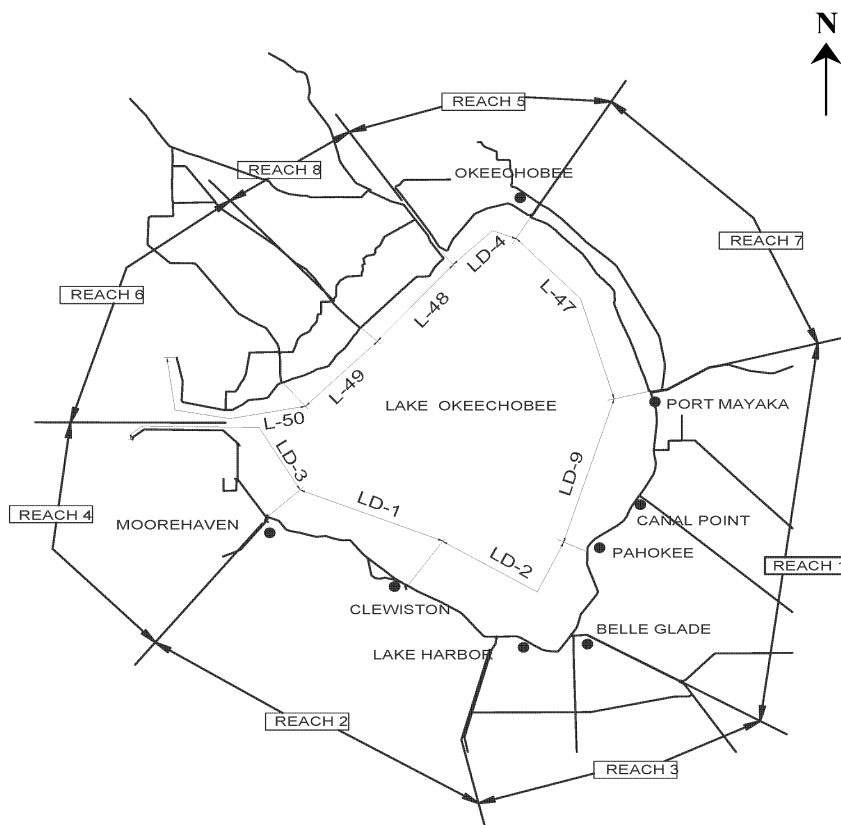


Figure 1: Reach Designations for HHD and Lake Okeechobee

Herbert Hoover Dike – Reach One

Specifically, Reach 1 subreach A (R1A) extends from the south side of the St. Lucie Canal at Port Mayaca (S-308) southwards to culvert structure C-10A, a distance of 4.6 miles. R1B&C continues from C-10A southwards to culvert structure C-10, a distance of about 10.5 miles. R1D continues southward from C-10 to structure S-351 in Belle Glade, a distance of about 7.3 miles.

The recommended plan for the entire Reach 1, as contained within the MRR, is shown in Figure 2. It recommends constructing a gravel-filled trench and placing a 48-inch diameter pipe within the existing toe ditch landward of the HDD. This culvert and trench would then be covered with a gravel berm. A drainage swale would be needed further landward to capture stormwater and agricultural runoff. This plan called for a substantial amount of real estate acquisition as the berm and drainage swale would extend beyond the current right-of-way limits of the HDD. Additional alternatives considered during the MRR analyses were toe ditch weirs (Alternative A) and a cutoff wall (Alternative C).

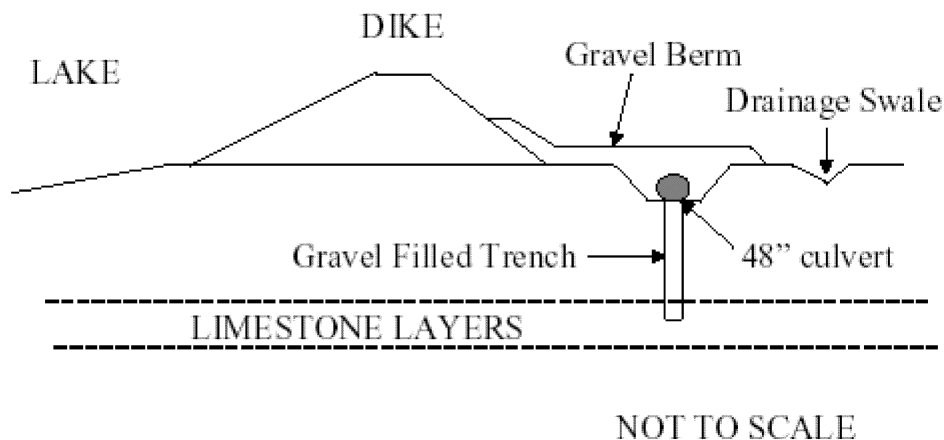


Figure 2: MRR Recommended Plan

An Independent Technical Review (ITR) involving an expert panel review and a deterministic technical review of the MRR was performed by the URS Group. Results further confirmed the need for remediation of HDD due to serious stability concerns. Although the possibility of a breach solely due to slope failure or sinkhole activities was ruled out, it was determined that these factors could be contributory to a breach of HDD. Seepage gradients were found to increase non-linearly as the lake elevation exceeds +20 feet. It is URS' opinion that given the existing geometry and condition of HDD and in absence of maintenance activity, seepage and piping-related dike breach would be likely as the lake elevation rises above +20 feet. In many cases, the factors of safety for the existing conditions for slope stability and piping are currently below minimum standards as set forth in guidance contained within EM 1110-2-1902 (Slope Stability) and EM 1110-2-1901 (Seepage Analysis and Control for Dams)

URS also performed the Value Engineering Study (VE) of the recommended MRR plan, along with active participation from USACE and the South Florida Water Management District (SFWMD). The VE study recommended an inverted filter with a relief trench, as shown in Figure 3. In two locations within R1, the VE plan also called for a cutoff wall. The VE plan would have terminated at the inside toe of the existing toe ditch, thereby eliminating the need for additional real estate acquisition.

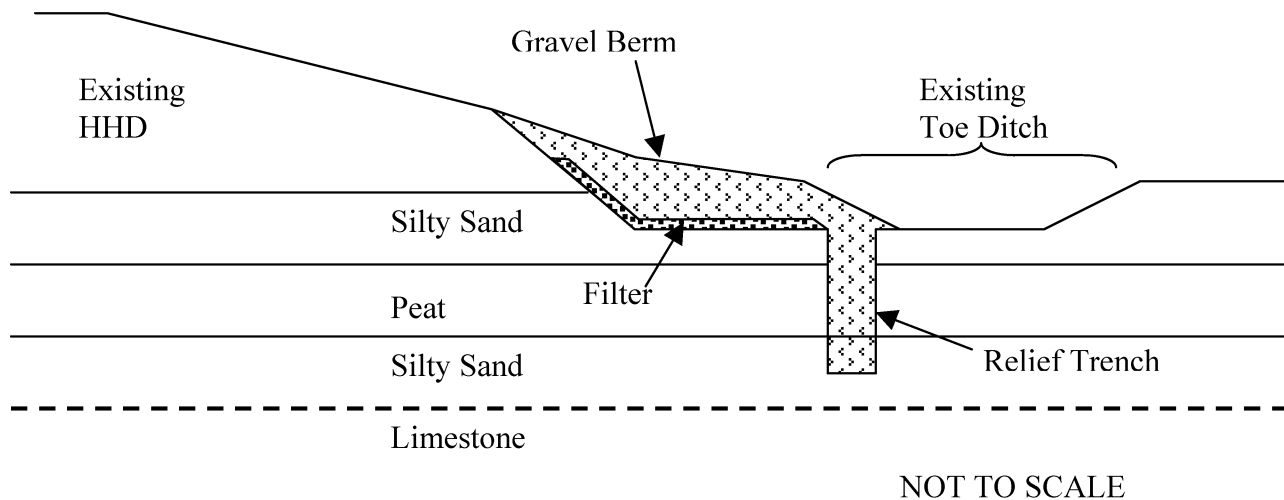


Figure 3: Conceptual Plan from VE Study

Design Documentation Report

In 2003, URS was contracted to develop a Design Documentation Report (DDR) of the conceptual VE plan for use in preparation of eventual Plans and Specifications (P&S) for construction within R1A. The Scope of Work (SOW) directed URS to consider geotechnical analyses for slope stability and safety against piping at lake elevations corresponding to the 100-year (el 21.3) and Standard Project Flood (SPF) (el 26) events. Existing conditions were modeled with the lake elevation equal to 18.5, roughly the 30-yr event.

At the 30% submittal of the DDR for R1A it was discovered through geotechnical analyses and field construction of test sections that the VE plan would actually increase groundwater flows to the toe ditch. This additional flow would contribute to flooding of adjacent properties. The functionality of the toe ditches is further complicated by the reality that local farmers will pump water into or out of the agricultural canals thus affecting the water level within the toe ditch. This is significant because the water level in the toe ditch is indicative of the tailwater condition during seepage (given the lake elevation as the headwater). If the water level inside the toe ditch is low, the larger head difference across HHD causes larger exit gradients that lower the factor of safety against piping/boils. If the water level inside the toe ditch is high, the pore pressures tend to increase, causing a reduction in shear strength that lowers the factor of safety against slope stability.

Correspondence between URS and USACE SAJ resulted in a modification to the SOW for the DDR such that any remedial solution applied to HHD should produce a stable structure, in terms of seepage, piping, and slope stability, that is independent of tailwater conditions. The SAJ district prefers not to be in the business of controlling HHD tailwater.

In order to satisfy the new design guidance, URS considered several possible rehabilitation solutions in their stability analyses. The only solution that satisfied all conditions of stability while not increasing groundwater flows to the toe ditch is shown below in Figure 4. The preferred solution is a combination of alternatives from both the MRR (cutoff wall) and the VE

study (relief trench). This is the same solution for which construction P&S and cost estimates have been prepared for R1A, also performed by URS.

The cutoff wall would be a self-hardening cementitious slurry wall two feet thick and approximately 35 feet deep. The relief trench and gravel berm would be filled using washed, crushed stone that is graded from ½ to 1 inch. The relief trench would be lined with a geotextile filter fabric to inhibit piping by preventing the migration of fine particles.

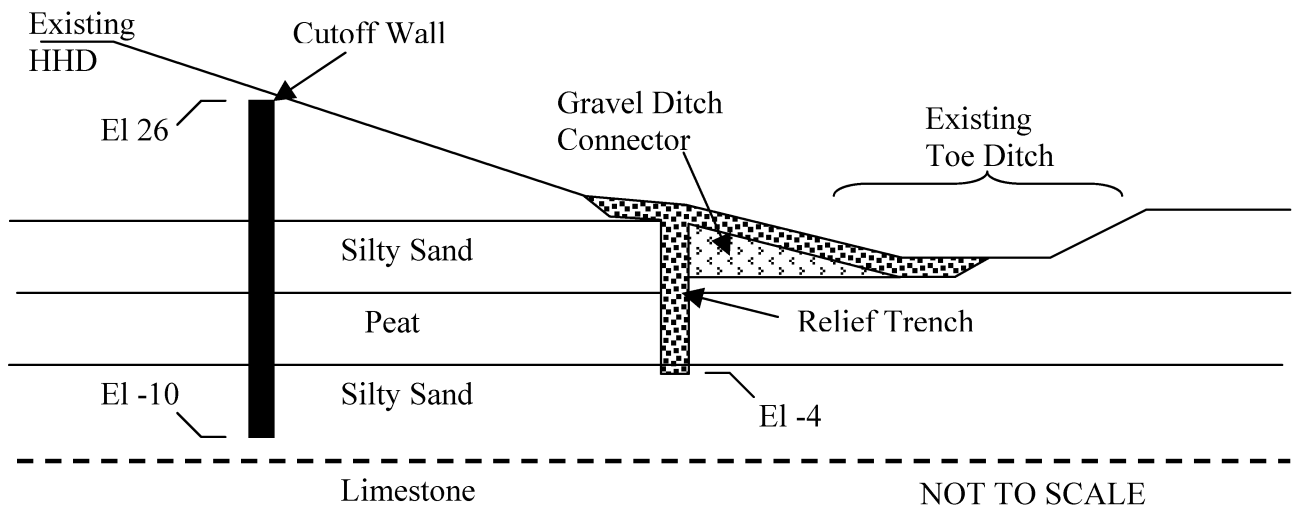


Figure 4: Preferred Solution from DDR R1A

DDR's for R1B&C, by URS, and R1D, by Civil Services, Inc (CSI), are currently being prepared. The same design guidance incorporated into the DDR R1A is being employed during seepage and stability analyses for these remaining DDR's for Reach 1. However, due to variations in subsurface geology, dike geometry, and surface features, it should be expected that the final recommended plans will vary as conditions warrant from the preferred plan for R1A. The overall intent of the rehabilitation of HHD is to have a stable structure, independent of tailwater conditions, that satisfies global stability and factors of safety against piping/boils, that does not burden the maintenance department with additional concerns, nor should the solution negatively impact regional groundwater flow.

Cost Analysis

A cost analysis was performed by the VE section of SAJ that describes the genesis of project costs from the MRR solution to the current P&S preferred solution. In summary: the construction cost of the original MRR solution was about \$80M. Accounting for escalation costs, inflation, revised real estate, and revised construction quantities, the current dollar amount estimated for construction of the MRR solution is about \$107M. A construction cost estimate has been performed only for the R1A section for which P&S have been prepared (the DDR's are in-progress for the remaining subreaches of R1). When the estimated R1A construction cost is extrapolated to the entire R1, the current P&S preferred solution is estimated to be about \$127M. More information on the costs is presented in Annex F of the Supplemental Draft EIS.

SUMMARY
SUPPLEMENTAL DRAFT
ENVIRONMENTAL IMPACT STATEMENT
ON
PROPOSED REHABILITATION OF
HERBERT HOOVER DIKE - REACH ONE
MARTIN AND PALM BEACH COUNTIES, FLORIDA

Background

The Herbert Hoover Dike (HHD) consists of a series of levees, gated culverts, and locks that encompass Lake Okeechobee in south central Florida. Construction of the HHD began early 1900's as the first embankments around the lake were constructed in 1915 by local interests and were primarily composed of muck, sand, shell, and marl from adjacent borrow canals. A federal interest to build a dike was initiated after the hurricanes of 1926 and 1928 caused flood waters to overtop the original embankment, resulting in over 2,600 deaths. The River and Harbor Act, approved July 3, 1930, authorized the construction of 67.8 miles (109 kilometers (km)) of levee along the south shore of the lake and 15.7 miles (25.3 km) of levee along the north shore. The typical crest height of those levees ranged from 32 to 35 feet (9.8 meters (m) to 10.7 m) above the National Geodetic Vertical Datum of 1929 (NGVD). These levees were constructed by the Corps between 1932 and 1938. A major hurricane in 1947 prompted the need for additional flood protection work in Florida. In response, Congress passed the Flood Control Act of 1948 authorizing the first phase of the comprehensive plan for flood protection and other water control. Later, major culvert modifications were accomplished in the 1970s.

Until recently only as-needed repairs have been made to the HHD. However, signs of instability, such as boils and pipings, have occurred in recent years that indicate major renovations are now necessary, especially along the southeastern portion of the HHD. High lake levels in 2003 resulted in severe piping that required several emergency operations to remediate the HHD along the eastern section of Reach 2 and portions of Reach 3. The greatest risk is that an unreliable embankment system could allow for a failure of the system to contain lake waters. Such a failure could result in loss of life, property, and habitat.

The existing HHD is approximately 143 miles (230 km) long. It is divided into eight segments or "Reaches" for planning purposes. The southeastern segment, Reach One, is the focus of the present study. It is an approximate 22.4-mile (36 km) long segment of the HHD located along the southeast portion of the lake, extending from the St. Lucie Canal at Port Mayaca, south to the Hillsboro Canal at Belle Glade (Figure 1).

On August 6, 1999 the Draft Environmental Impact Statement for the Herbert Hoover Dike Major Rehabilitation Evaluation Report (MRR) was noticed in the Federal Register and released to for public and agency comment. The recommended plan to rehabilitate the HHD included installation of a seepage berm with a relief trench along the landward toe of the embankment. The recommendation also included the addition of a drainage swell for conveyance of storm and irrigation water. Anticipated impacts of this design included wetland habitat removal and associated loss of fish and wildlife resources, especially foraging habitat for wading birds and listed species; additional real-estate acquisition, including property in ownership of private individuals; and minimal impacts to agriculture due to changes in drainage canals used for

irrigation. Mitigation for loss of wetland function and habitat had been proposed to offset the impacts to fish and wildlife resources. All other impacts were anticipated to be minor.

The Herbert Hoover Dike MRR was approved in November 2000 contingent on revisions to the economic evaluation. In 2001, a Value Engineering (VE) study was initiated for the project in order to reduce real-estate costs and minimize the footprint of the project within functional wetlands. Completed in July 2002, the VE study recommended excavating the toe of the landward dike and replacing with a gravel filter, as well as installing a seepage trench similar to the MRR, but lakeward of the toe berm. The existing toe ditch would be used for drainage and conveyance of water, but with no tailwater management or any control of groundwater brought to the surface.

In 2002 through 2003, emergency repairs to the Dike were undertaken to stop boils occurring in the toe ditch near South Bay. The boils were occurring with the lake elevation near 15-ft NGVD. With the oncoming wet season and projections of the lake rising above 17-ft NGVD during hurricane season, emergency actions were taken to install the VE solution over a one-mile stretch. This area was instrumented to determine performance of the VE solution. The VE recommendation proved to be unsuccessful due to the added water to the toe ditch from the seepage trench conveying ground water to the surface. Additional waters were in fact being introduced onto adjacent private properties. Discussion about how to prevent additional water seepage, constrained by not having tail water management, and limiting real-estate requirements led the Corps to modify the alternatives of the MRR and VE and is reflected in the current Supplemental MRR and Supplemental Draft EIS. The Supplemental MRR combines alternatives 2 and 3 of the Draft EIS, modifying the cut-off wall to only extend as deep as needed to offset the additional water being brought to the surface by the seepage trench, accomplishing the project objective to provide stability and reduce piping along the dike, as well as provides flood control. This solution does not impact the regional groundwater system. In addition, the recommended plan reduces the construction activities to within the existing footprint of the dike, minimizing to eliminating the impacts to wetlands, fish and wildlife resources, threatened and endangered species, and agricultural users that were anticipated with implementation of the original recommendation of the MRR.

Alternatives

The Corps has developed and evaluated several alternatives to reduce the probability of a breach of Reach One of the HHD. The first alternative, the No Action Alternative would involve making no improvements to the embankment at Reach One. Alternative No. 1 would involve the construction of a stability berm, improvements to existing drainage ditches, and regulation of the water level in the ditch system. Alternative No. 2 proposes the construction of an impervious cutoff wall and landside stability berm. Alternative No. 3 involves the installation of a seepage berm with relief trench along the landward toe of the embankment. Alternative No. 4 involves a hanging cut-off wall and a relief trench with a french drain system as a toe berm, all within the footprint of the existing HHD.

Preferred Alternative(s)

Alternative No. 4 is the Corps' preferred alternative. It involves construction of approximately 22 miles of a pervious hanging cut-off wall on the landward side of the dike, at approximately 26-ft NVGD, and a relief trench in Reach One of the HHD on the lakeward side of the existing dike's toe ditch. Alternative No. 4 minimizes the project's footprint to existing HHD's footprint as well as reduces overall impacts to the natural system when compared to the other alternatives.

Alternative No. 4 was added in the Supplemental MRR after a value engineering report, emergency operations constructions, and initial designing for the HHD rehabilitation were able to demonstrate that by using a combination of a hanging cut-off wall and relief trench to achieve the project goals, impacts to existing wetlands, wildlife habitat, agricultural users, and ground water would be minimized. Unlike the other alternatives, this alternative would not significantly impact the resources landward of the existing toe ditch at the HHD's base. In addition, real-estate requirements have been limited to the HHD's existing footprint. This alternative is a product of continual improvement on the design to meet seepage issues and environmental concerns. Thus, it had not been evaluated in the original EIS. Since this alternative reduces all previously developed alternatives' impacts to minimal or no impact, is a refinement of the original preferred alternative (Alternative No. 3), but not presented in the prior analysis, and the draft EIS was circulated more than 5 years ago, the Corps is circulating this supplement to the draft EIS to provide the analysis to the new recommended plan. All alternatives will be fully analyzed in this Supplemental Draft EIS.

The design of the preferred alternative includes a hanging seepage cutoff wall on the landward side of the dike slope and a relief trench with an inverted filter and relief berm at the toe of the landward slope of the dike, stopping at the dike's toe ditch. The cut-off wall will be at the approximate 26' elevation on the HHD slope, excavation stopping prior to the impervious geologic layer. This will allow groundwater to flow beneath the HHD and underseepage to be collected by the relief trench. The relief trench and inverted filter will be constructed adjacent to the existing toe ditch and within the HHD footprint at the landward toe. An access road would be built on top of the relief trench. The plan is similar to the MRR solution Alternative No. 3, but would not contain a closed conduit as outlined in the MRR and utilizes the hanging cut-off wall to prevent piping. The closed conduit would be replaced with the existing open toe ditch for removal of seepage. Seepage water from the seepage toe berm and relief trench would flow freely into the existing toe ditch. The toe ditch geometry may have to be altered on the lakeward side of the ditch due to construction of the trench and drain system. The final design has to insure no negative impact of flood control. This may cause some slight design changes in certain areas (i.e., length of cutoff wall), but the impact of the design would encompass less land than the original MRR solutions (Alts. 1 through 3).

Two other slight variations of the Inverted Filter with Seepage Trench are proposed along Reach One where special considerations, such as existing infrastructure, require a design change to fit HHD geometry and real estate requirements.

Just south of culvert C-12, a rock quarry lies adjacent to the landside toe of the embankment (Figures 7 and 10). In this area, there is insufficient space between the embankment toe and quarry bank to allow construction of the proposed drainage berm; therefore, filling of the quarry would be necessary prior to construction in this area. Fill material (approximately 500,000 cubic yards (382,000 cubic meters)) would be obtained from existing Corps stockpiles of suitable spoil material and/or from a licensed commercial upland source. After quarry filling, the drainage berm would be constructed on the reclaimed lands.

A water filtration plant in Pahokee is located just north of the HHD access road and is directly adjacent to the HHD landward side. The filtration plant would require special design considerations for the HHD rehabilitation. The preferred alternative for this HHD rehabilitation would be very similar to the rock quarry concept above. A 3-foot wide trench would be excavated on the center of the HHD to a depth of -6 elevation. The trench would be filled with slurry to form an impenetrable wall to ensure dike stability in this area. Similar design,

construction materials and dimensions would be utilized in this area to ensure dike stability in the immediate quarry area. See the MRR for more details.

Major Conclusions

Implementation of Alternative No. 4 would cause minimal short-term disturbance to, and displacement of, components of the human and natural environments. These include minimal soil, vegetation, and wetland disruption during excavation and fill activities. Impacts to water resources have been minimized by avoiding wetlands within and landward of the existing toe ditch throughout the entire length of Reach One. Minimal and temporary impacts are expected to water resources, foraging habitat for wading birds, and listed species. Temporary displacement of an existing low voltage transmission line is the only moderate impacts expected. Implementation of this alternative would improve slope stability and seepage control and reduce the probability of a dike breach within Reach One. Due to these factors, Alternative No. 4 has been selected as the preferred alternative.

The No Action Alternative would cause no physical changes in the study area, nor would it provide acceptable compliance with current regulation requirements of safety factors relative to dike stability. This alternative does not provide adequate protection from the seepage and stability problems that threaten critical areas of Reach One of the HHD. Furthermore, there could be significant socioeconomic implications, as it could allow for continued degradation of the HHD's stability leading to a breach. The potential for loss of life and property from a breach is significant to residents along the HHD as well as those that utilize the HHD for recreation. Human well being and safety may be severely impacted and damage to property significant in the event of a levee breach between the Hillsboro and West Palm Beach Canals, especially as there is significant urban and residential development very close to the HHD in this area. Finally, in the event of a high velocity breach in the general area between the St. Lucie Canal and the L-8 Canal, in combination with high lake levels, a downstream discharge towards the St. Lucie Estuary would likely cause significant adverse impacts to the estuarine ecosystem. It is reasonable to assume that any levee breach of the HHD system would likely be preceded by significant freshwater releases through the S-308 at Port Mayaca in anticipation of climatic and lake inflow conditions raising water levels and threatening the stability of the HHD. As a result of the above potential adverse scenarios this action was not selected as the preferred alternative.

Implementation of Alternative No. 1 may potentially result in some adverse impacts to the existing environment. Minimal impacts to the soil, vegetation, and wetlands during excavation and fill activities may occur. Moderate impacts to water resources may result from modifications involved in this alternative. Minimal alteration of foraging habitat for wading birds and listed species along the toe ditch would occur as well. Further, impacts to local agriculture are possible if the local drainage districts and farmers are relieved of the control of irrigation water through implementation of this alternative. This alternative does not provide adequate protection from the seepage and stability problems that threaten critical areas of Reach One of the HHD, as a result, this action was not selected as the preferred alternative.

Implementation of Alternative No. 2 may potentially result in some adverse impacts to the existing environment. These include minimal soil, vegetation, and wetland disruption during excavation and fill activities. Moderate impacts to water resources may result from modifications involved in this alternative, and minimal alteration of foraging habitat for wading birds, and listed species along the toe ditch would occur. Further, impacts to local agriculture are possible if the hydrology is reduced by the cutoff wall proposed by this alternative. This alternative would improve slope stability and seepage control along Reach One. However, due to the intensive

effort of this action and the effects of the cutoff wall to the local groundwater regime, this action was not selected as the preferred alternative.

Implementation of Alternative No. 3 would cause minimal short-term disturbance to, and displacement of, components of the human and natural environments. These include minimal to moderate impacts to soil, vegetation, and wetland disruption during excavation and fill activities. Impacts to water resources through filling of landward toe ditches would be expected and require mitigative measures; Therefore moderate impacts would be expected to water resources, foraging habitat for wading birds, and listed species. Temporary displacement of an existing low voltage transmission line is a moderate impact expected. Implementation of this alternative would improve slope stability and seepage control. Due to these moderate impacts, Alternative No. 3 has not been selected as the preferred alternative.

Issues Raised by Public and Agencies

Several concerns were raised during the Scoping process, including concerns regarding impacts to scenic trails, wetlands, threatened and endangered species, and navigation. Additionally, erosion control and increased lake water level were of expressed interest.

The Florida Department of Transportation (FDOT) expressed concerns about possible impact on the Lake Okeechobee Scenic Trail, especially with respect to trail alignment, trailhead configurations, location of trail amenities, levee crown surface improvements, and the placement of bicycle/pedestrian bridge structures over navigable locks.

Additionally, the Florida Department of Environmental Protection (FDEP) recommended an evaluation of the direct and secondary impacts of this project on the existing wetlands where levees and structures are to be constructed, including a consideration of the current condition and function of those wetlands. Mitigation should be included in the project to replace lost wetland functions. The FDEP also recommends that land forms and water regulation strategies be structured to meet the ecological restoration objectives of the greater Everglades system.

The Florida Game and Fresh Water Fish Commission (FGFWFC), reorganized in 1999 into the Florida Fish and Wildlife Conservation Commission (FFWCC), remarked that impacts of any dike hardening proposals on turtle nesting habitat should be thoroughly documented and analyzed. Further, nesting habitat for the burrowing owl (*Speotyto cunicularia floridana*), a state listed species of special concern, may be impacted. A detailed population study of burrowing owls on the entire dike system, along with an analysis of the impact of dike improvement options on this population should be conducted.

The Okeechobee Waterway Association of Clewiston, Florida, and the Marine Industries Association of Florida, Inc. of Stuart, Florida each had concerns regarding access to and navigation of the lake. Erosion control of the dike system was an expressed concern by the City of Pahokee, and well as that of private citizens in the area of Reach One.

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**HERBERT HOOVER DIKE - REACH ONE
ENVIRONMENTAL IMPACT STATEMENT**

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ANNEX F – Supplemental Major Rehabilitation Evaluation Report Cost Estimates for Reach 1

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LIST OF ACRONYMS

bls	BELOW LAND SURFACE
BMPs	BEST MANAGEMENT PRACTICES
CFR	CODE OF FEDERAL REGULATIONS
CAR	COORDINATION ACT REPORT
C&SF	CENTRAL AND SOUTHERN FLORIDA PROJECT
Corps	US ARMY CORPS OF ENGINEERS
dB	DECIBELS
DEIA	DRAFT ENVIRONMENTAL IMPACT STATEMENT
DDR	DRAFT DESIGN REPORT
EAA	EVERGLADES AGRICULTURAL AREA
EIS	ENVIRONMENTAL IMPACT STATEMENT
EPA	US ENVIRONMENTAL PROTECTION AGENCY
FDACS	FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES
FDEP	FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
FDOT	FLORIDA DEPARTMENT OF TRANSPORTATION
FFWCC	FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
FGFWFC	FLORIDA GAME AND FRESHWATER FISH COMMISSION
FMSF	FLORIDA MASTER SITE FILE
FNAI	FLORIDA NATURAL AREAS INVENTORY
FNST	FLORIDA NATIONAL SCENIC TRAIL
GLOTA	GREATER LAKE OKEECHOBEE TOURIST ALLIANCE
HHD	HERBERT HOOVER DIKE
HGS	HURRICANE GATE STRUCTURE
LAKE	LAKE OKEECHOBEE
MRR	MAJOR REHABILITATION EVALUATION REPORT
MWL	MINIMUM WATER LEVEL
NEPA	NATIONAL ENVIRONMENTAL POLICY ACT
NGVD	NATIONAL GEODETIC VERTICAL DATUM
NHPA	NATIONAL HISTORIC PRESERVATION ACT of 1966, as amended
NRHP	NATIONAL REGISTER OF HISTORIC PLACES
PSD	PREVENTION OF SIGNIFICANT DETERIORATION
SDEIS	SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT

SFWMD	SOUTH FLORIDA WATER MANAGEMENT DISTRICT
SHPO	STATE HISTORIC PRESERVATION OFFICER
USFWS	UNITED STATES FISH AND WILDLIFE SERVICE
VE	VALUE ENGINEERING
WCA	WATER CONSERVATION AREA

**SUPPLEMENTAL DRAFT
ENVIRONMENTAL IMPACT STATEMENT
ON
PROPOSED REHABILITATION AT REACH ONE
HERBERT HOOVER DIKE MAJOR REHABILITATION EVALUATION REPORT
MARTIN AND PALM BEACH COUNTY, FLORIDA**

1.00 THE PURPOSE AND NEED FOR THE ACTION

The Herbert Hoover Dike (HHD) consists of a series of levees, gated culverts and locks that encompass Lake Okeechobee. Construction of this dike began in 1915 as the first embankments around the lake were constructed by local interests and were primarily composed of muck, sand, shell, and marl from adjacent borrow canals. During the 1930s, a Federal interest was initiated as a result of the hurricane tides of 1926 and 1928 overtopping the original embankment and causing over 2,600 deaths. The River and Harbor Act, approved 3 July 1930, authorized the construction of 67.8 miles (109 kilometers (km)) of levee along the south shore of the lake and 15.7 miles (25.3 km) of levee along the north shore. Constructed by the Corps between 1932 and 1938, the typical crest height of these levees ranged from 32 to 35 feet (9.8 meters (m) to 10.7 m) above the National Geodetic Vertical Datum of 1929 (NGVD). A major hurricane in 1947 prompted the need for additional flood protection work in Florida. In response, Congress passed the Flood Control Act of 1948 authorizing the first phase of the comprehensive plan for flood protection and other water control. Additionally, major culvert modifications were accomplished in the 1970s.

In recent years, only as-needed repairs have been made to the HHD. However, signs of instability such as boils and pipings have occurred during recent years that indicate major renovations are now necessary, especially along the southeastern portion of the HHD. In 2003, emergency operations to remediate severe piping had been taken along the eastern portion of Reach 2 and sections of Reach 3. An unreliable embankment system could allow for a failure of the system to contain lake waters. Such a failure could result in loss of life, property, and habitat.

1.01 PROJECT AUTHORITY

The Herbert Hoover Dike is a component of the Central and Southern Florida (C&SF) Project. The Flood Control Act (Act), approved by Congress on

30 June 1948, authorized the first phase of a comprehensive plan to provide flood protection and other water control benefits in central and south Florida. The Act included measures for improving control of Lake Okeechobee by constructing or modifying the spillways and other structures, and enlarging the Lake Okeechobee levees to provide the intended flood protection, water storage and water supply. Levee seepage and stability have a direct effect on the capability of the levee to provide the authorized protection. The authorization for levee repairs and modifications of the Flood Control Act of 1948 justify the proposed renovation to Reach One of the HHD. Additional authorization for the C&SF Project was authorized in the Flood Control Act of 1954, 1960, 1965, and 1968; authorization in 1970 under Section 201 of the Flood Control Act of 1965; the Water Resources Development Acts of 1986, 1988, 1990, 1992, and 1996; and the Rivers and Harbors Act of 1930.

1.02 PROJECT LOCATION

The existing HHD system is approximately 143 miles (230 km) long, and comprises five counties: Glades, Hendry, Martin, Okeechobee, and Palm Beach. It is divided into eight segments or “Reaches” for planning purposes. The southeastern segment, Reach One, is the focus of the present study. Reach One is an approximately 22.4 miles (36 km) long segment of the HHD located along the southeast portion of the lake. This segment extends from the St. Lucie Canal at Port Mayaca, south to the Hillsboro Canal at Belle Glade (Figure 1).

1.03 PROJECT NEED AND OPPORTUNITY

The HHD, constructed largely of local material (e.g., mud, muck, sand, shell fragments) and with porous limestone bedrock underlying the levee, has been experiencing a high degree of underseepage and seepage through the levee. This seepage resulted in several boils and pipings during the 1995 and 1998 high water events. The most significant occurrences were found along Reach One.

An unreliable embankment system, such as that which currently exists along Reach One of the HHD,

could allow for a failure of the system to contain lake waters. Such a failure could result in loss of life, property, and habitat. A reasonable and effective rehabilitative effort is required to eliminate this possibility

1.04 AGENCY OBJECTIVE

The Corps has conducted a structural and stability analysis study on the HHD that has culminated in an MRR for Reach One. The general goal of the HHD MRR was to provide a reliable embankment system around Lake Okeechobee to contain the lake waters for flood protection, water supply, and navigation. In July 2002, a VE study was completed to further refine the engineering alternatives and attempt to limit the area of impact of the preferred alternative. In addition, emergency repairs and early design documents modified the preferred alternative to further reduce project impacts on wetlands and fish and wildlife habitat. This modification is presented in this document as Alternative No. 4. Based on these evaluations, the Corps is proposing several alternatives to reduce the probability of a breach along Reach One of the HHD.

1.05 RELATED PROJECTS AND ENVIRONMENTAL DOCUMENTS

Final Environmental Impact Statement, Lake Okeechobee Regulation Schedule Study, US Army Corps of Engineers, Jacksonville District, November 1999.

1.06 DECISION TO BE MADE

This SDEIS will evaluate whether to improve the structural stability to reduce risks of a breach at Reach One of the HHD and, if so, evaluate alternatives to accomplish that goal.

1.07 SCOPING AND ISSUES

A scoping letter was sent in September 1996 to interested federal, state and local agencies, Indian tribes, interested organizations and the public requesting their comments and concerns regarding rehabilitation of the HHD. Responses included concerns regarding impacts to scenic trails, wetlands, threatened and endangered species, and navigation. Additionally, erosion control and increased lake water level were of expressed interest.

The Florida Department of Transportation (FDOT) was concerned about the possible impact of the project to the Lake Okeechobee Scenic Trail segment of the Florida National Scenic Trail, especially with respect to trail alignment, trailhead configurations, location of trail amenities, levee crown surface improvements, and the placement of

bicycle/pedestrian bridge structures over navigable locks.

The Florida Department of Environmental Protection (FDEP) recommended that the project include the removal of *Melaleuca quinquenervia* from the project area. The FDEP further recommended an evaluation of the impacts of the project on the existing wetlands, including a consideration of the current condition and function of those wetlands. Mitigation should be included in the project to replace lost wetland functions. Water Quality Certification through the state's Environmental Resources Permitting process would be required for new water flow regulation structures and levees. The FDEP recognizes that construction and hydroperiod modification may threaten populations of the Okeechobee Gourd (*Cucurbita okeechobeensis*). The FDEP also recommended that land forms and water regulation strategies be structured to meet the ecological restoration objectives of the greater Everglades system.

The Florida Game and Fresh Water Fish Commission (FGFWFC), reorganized in 1999 to the Florida Fish and Wildlife Conservation Commission (FFWCC), remarks that the HHD provides major nesting habitat for Lake Okeechobee's aquatic turtles, and the impacts of any dike hardening proposals on turtle nesting habitat should be thoroughly documented and analyzed. Further, the HHD provides nesting habitat for the burrowing owl (*Speotyto cunicularia floridana*), a state listed species of special concern. The FGFWFC recommends that a detailed population study of burrowing owls on the entire dike system, along with an analysis of the impact of dike improvement options on this population be conducted.

The Okeechobee Waterway Association of Clewiston, Florida, and the Marine Industries Association of Florida, Inc. of Stuart, Florida each responded to the Scoping process with concerns regarding access to and navigation of the lake, and any impact to these issues that a rehabilitation effort might cause. Erosion control of the dike system was an expressed concern by the City of Pahokee, and well as that of private citizens in the area of Reach One.

During preparation of this SDEIS, the responses to the scoping letter, as well as comments to the DEIS, were addressed. Further, in order to determine the potential environmental impacts associated with implementing rehabilitative measures along Reach One, a detailed examination of proposed alternatives

and the existing environment was accomplished. Specific issues addressed include hydrology, water management, wetlands, flora and fauna, land resources, socio-economics, and others. Additionally, these issues were addressed in lesser detail for the remaining Reaches comprising the entire HHD system.

1.08 PERMITS, LICENSES, AND ENTITLEMENTS

The proposed HHD repairs are subject to Section 402 of the Clean Water Act and would require Water Quality Certification from the FDEP.

The local Sponsor, South Florida Water Management District (SFWMD), has the responsibility for acquiring all lands and easements for project implementation.

2.00 ALTERNATIVES CONSIDERED

There are five alternatives currently under consideration, including the No Action Alternative. The details of each alternative are presented below.

2.01 NO ACTION ALTERNATIVE

The No Action Alternative is defined as not taking actions or making physical alterations to improve or repair the HHD within Reach One. It would maintain the current condition of the dike (Figure 2). The No Action Alternative would not provide acceptable compliance with current regulation requirements of safety factors relative to dike stability. Without acceptable improvements to Reach One of the HHD, the safety of the surrounding human and natural environment may be severely impacted with subsequent effects upon the local and regional economies. The continuation of piping and boils occurring in this area would increase the potential for local flooding due to rainfall and runoff. In the event of a total breach significant impacts to human life, existing soils, vegetation, water resources, habitat, threatened and endangered species, agriculture and property would result.

The future without project, or the No Action Alternative, does not provide a long-term solution to the seepage and stability problems existing along Reach One. For these reasons, the No Action Alternative is not feasible and will not be considered further.

2.02 ALTERNATIVE ACTIONS

Alternative No. 1

This alternative includes increasing the water level in the drainage ditches and the construction of a stability berm at the landside toe of the levee (Figure 3). Alternative No. 1 would improve the existing drainage ditches by cleaning out the ditches and re-grading the ditches. Culverts with automatic/manual gates and pumps would be installed to control the water level in the ditches. During critical high water periods, the water level in the ditches would be raised in order to limit the differential head across the levee. Raising the water levels in the ditches would increase the local flooding potential due to rainfall and runoff. Presently, local drainage districts and farmers control most of these ditches.

Additionally, 3 feet (ft) to 4 ft (0.9 m to 1.2 m) of peat would be excavated from the landside toe of the levee. Then a 25 ft (7.6 m) wide, 5 ft (1.5 m) deep stability berm would be constructed. The stability

berm would allow access to the toe of the embankment and ditches for inspection.

This alternative does not provide adequate protection from the seepage and stability problems that threaten critical areas of Reach One of the HHD.

Alternative No. 2

Alternative No. 2 involves an upstream impervious cutoff wall and a landside stability berm at the toe of the levee (Figure 4). The cutoff wall would impede groundwater flow. This is the most positive method of underseepage control because it reduces both uplift pressure and through seepage. The wall would consist of a 3 ft (0.9 m) wide, 60 ft (18 m) deep excavation filled with soil-bentonite or soil-cement mixture. The top of the wall would be at an approximate elevation of 25 ft (7.6 m). The cutoff wall would affect the upper aquifer and may lower the groundwater table, thereby affecting local adjacent farms. A landside stability berm as described in Alternative No. 1 would also be constructed. Due to the intensive construction effort, costs, and the effects of the cutoff wall to the local groundwater regime, this action was not selected as the preferred alternative.

Alternative No. 3

Alternative No. 3 includes the installation of a seepage berm with a relief trench and a french drain system along the landward toe of the HHD (Figure 5). In areas where the HHD toe rests on a peat layer, construction of the seepage berm would begin with excavation of peat material from the landside toe. No excavation would be performed at higher elevations of the embankment slope.

The seepage berm would be constructed along the lower portion of the embankment toe. In areas where a toe ditch now exists, the ditch would be replaced by the proposed seepage berm. The landward side of the berm would contain perforated culvert. A deep relief trench would be excavated immediately below the culvert within the toe ditch and along its entire length. The berm would prevent the piping of sands and silts from the embankment and its foundation. The relief trench is designed to control uplift pressures and prevent seepage and piping flows from extending landward of the embankment. The perforated culvert system would collect and convey seepage flows to controlled outlets that empty into existing drainage canals. A drainage swale would also be constructed along the landward toe of the

berm to collect and convey surface drainage from each side of the drainage berm.

2.03 PREFERRED ALTERNATIVE ACTION

Alternative No. 4

Alternative No. 4 is the preferred alternative. The design includes a hanging seepage cutoff wall on the landward side of the dike slope and a relief trench with an inverted filter and relief berm at the toe of the landward slope of the dike, stopping at the HHD's toe ditch. The cutoff wall would be at approximately 26-foot elevation on the HHD slope, excavation stopping prior to the impervious geologic layer. This would allow groundwater to flow beneath the HHD and underseepage to be collected by the relief trench. The relief trench and inverted filter would be constructed adjacent to the existing toe ditch and within the HHD footprint at the landward toe. An access road would be built on top of the relief trench. The plan is similar to the MRR solution Alternative No. 3, but would not contain a closed conduit as outlined in the MRR and utilizes the hanging cut-off wall to prevent piping. The closed conduit would be replaced with the existing open toe ditch for removal of seepage. Seepage water from the seepage toe berm and relief trench would flow freely into the existing toe ditch. The toe ditch geometry may have to be altered on the lakeward side of the ditch due to construction of the trench and drain system. The final design would insure no negative impact of flood control. This may cause some slight design changes in certain areas (i.e., length of cutoff wall), but the impact of the design would encompass less land than the original MRR solutions (Alts. 1 through 3).

There are also two other slight variations of the inverted filter with seepage trench proposed along Reach One where special considerations, such as existing infrastructure, led to slight design change to better-fit HHD geometry and real estate requirements.

Just south of culvert C-12, a rock quarry lies adjacent to the landside toe of the embankment (Figures 7 and 10). The quarry is 3,000 ft (914 m) long, 10 ft to 20 ft (3 m to 6 m) deep, and contains water. Partial filling of the quarry near the HHD toe would be necessary to facilitate construction of a seepage berm with cutoff wall and relief trench. A 3-foot wide trench would be excavated on the center of the HHD to a depth of minus 6-foot elevation. The trench would be filled with slurry to form an impenetrable wall to ensure dike stability in this area. Similar design, construction materials and dimensions would

be utilized in this area to ensure dike stability in the immediate quarry area.

A water filtration plant in Pahokee is located just north of the HHD access road and is directly adjacent to the HHD landward side. The filtration plant would require special design considerations for the HHD rehabilitation. The preferred alternative for this HHD rehabilitation would be very similar to the rock quarry concept above. A 3-foot wide trench would be excavated on the center of the HHD to a depth of -6 elevation. The trench would be filled with slurry to form an impenetrable wall to ensure dike stability in this area. Similar design, construction materials and dimensions would be utilized in this area to ensure dike stability in the immediate quarry area. See the MRR or VE report for more information.

2.04 ENVIRONMENTALLY PREFERRED ALTERNATIVE

The Environmentally Preferable Alternative is that alternative, which if implemented, would result in the least conceivable adverse impacts to the existing environment.

A thorough analysis of the Affected Environment and potential Environmental Consequences as put forth in Sections 3.00 and 4.00 of this document, respectively, has led to the conclusion that Alternative No. 4 is the Environmentally Preferable Alternative for rehabilitation of Reach One of the HHD. Alternative No. 4, if implemented, would result in only minimal adverse impacts to the majority of the affected environmental components. Impacts to fish and wildlife resources, threatened and endangered species, and wetlands have been limited, and only temporary minimal impacts by construction are anticipated. Temporary displacement of an existing low voltage transmission line is the only moderate impacts expected.

Alternative Nos. 1, 2, and 3 are still viable alternatives for rehabilitation of Reach One of the HHD. These options would likely result in overall minimal to moderate impacts to the existing environment. Environmental components that deem these alternatives less desirable are largely related to increased expected impacts to water resources in this area.

The No Action Alternative is an unsatisfactory alternative, as it allows for continued degradation and instability of the HHD system. As presented in this document, the loss of life, property, and environmental resources stand to be great if no action

is taken and a major failure of the system should occur.

2.05 MITIGATION MEASURES

Measures to mitigate against environmental perturbations include erosion and surficial water control. Flexible fencing and/or hay may be used to control erosion during construction activities. Severe surficial water imbalances would be restricted to a minimum by performing the operations during the driest parts of the year. Mitigation would not be required with the construction of the Preferred Plan. However, mitigation is anticipated for future impacts along Reaches 2 and 3, and will be analyzed as part of the effects analysis for those reaches. However, the Fish and Wildlife Coordination Act Report documents the wetland assessment conducted in Reach One that could be used to determine mitigation if design changes and impacts to wetland habitat become a factor.

3.00 AFFECTED ENVIRONMENT

3.01 INTRODUCTION

Discussions of the affected environment included in this section describe the environment surrounding Reach One of the HHD and Lake Okeechobee as it currently exists. Environmental components include physical, biological, social, and economic resources. This Section does not present effects, but puts forth the baseline environment for comparisons in Section 4, Environmental Consequences.

3.02 CLIMATE

Lake Okeechobee is located in a region characterized by a humid subtropical climate. The lake has an area of approximately 720 square miles (1865 square kilometers) with its approximate center near 26° 56' 55" north latitude, 80° 56' 34" west longitude. Summers are long and warm typified by frequent afternoon convection storms. Winters are mild with the temperatures rarely falling below freezing. The summer months constitute the wet season, the winter months the dry season. Prevailing winds in the area vary from southeast to east-northeast, except during winter when winds are from a northwesterly direction. The annual mean wind speed is 9.4 miles per hour (15 km per hour) (USDA, 1978).

The most significant factor affecting the climate of the Lake Okeechobee area is its proximity to large water bodies. Although located on a parallel occupied primarily by arid lands around the world, the maritime effects of the Gulf of Mexico and the Atlantic Ocean on this area result in a significantly modified climate. The climate surrounding the lake is further influenced by the lake itself. Because the lake stays cooler than the surrounding land during warm days, and warmer than the land at night, the pressure differences and consequent winds significantly affect the local environment. The cooler lake temperatures during the day have a suppression affect on cloud formation over and near Lake Okeechobee. On remote imagery, the lake often appears as a hole in the cloud cover, sometimes being cloud free when surrounding areas contain significant cloud cover. Consequently, there is generally up to a 30 percent reduction in annual rainfall over and west of the lake compared to surrounding areas (Henry et al, 1994). Climate data from points around Lake Okeechobee are presented in Table 1.

The climate of Reach One is comparable to the climate of the Lake Okeechobee region. Data from

the Belle Glade Experiment Station are an accurate representation of the conditions typical of Reach One.

3.03 TOPOGRAPHY, GEOLOGY AND SOILS

Topography

The topography of lands surrounding Lake Okeechobee is flat to gently sloping with an elevation ranging from 10 to 20 ft (3 m to 6 m) NGVD. The area can be divided into three physiographic regions: (1) the Sandy Flatlands to the west and north of the lake which slope gently towards the lake; (2) the Eastern Flatlands to the east of the lake which slope gently towards the lake; and (3) the Everglades Region to the south, southeast, and southwest of the lake that generally slope away from the lake. (Klein et al, 1964; Lichtler, 1960).

Reach One exists entirely within the Everglades physiographic region with typical surface elevations ranging from 12 to 14 ft (3.6 m to 4.3 m) NGVD. The elevation at the crest of the HHD in Reach One ranges from 37.8 ft to 38.3 ft (11.5 m to 11.7 m) NGVD. Landward of the crest, the general slope of the HHD is from 20 to 33%, waterward the general slope is 17%. The mean Lake Okeechobee water surface elevation is 14.5 ft (4.4 m) NGVD, although this level varies from one side of the lake to another depending upon wind speed and direction. Depths of the lake within 1 mile (1.6 km) of the HHD range from 1 ft (30 cm) to 11 ft (3.4 m) below the mean water level in natural areas, and are approximately 38 ft (11.6 m) below mean water level in the rim canal.

Geology

The geological formations underlying Lake Okeechobee can be divided into two distinct groups, one that occurs in the Sandy and the Eastern Flatlands region, and one that occurs in the Everglades region.

In the Flatlands region, Pamlico Sand composed primarily of sand and limestone of the Late Pleistocene, occurs from 0 to 10 ft (0 m to 3 m) below land surface (bls). The Anastasia Formation

Table 1
Average Annual Temperatures and Rainfall
For Locations Surrounding Lake Okeechobee
1961 - 1990
(Southeast Regional Climate Center)

Annual Average:	MinTemp (F)	MaxTemp (F)	AvgTemp (F)	AvgPrcp (Inches)
Canal Point, USDA	62.5°	83.7°	73.1°	50.1°
Belle Glade, ExpStn	61.8°	83.3°	72.6°	51.6°
Clewiston, Corps	64.5°	83.5°	74.0°	45.0°
Moore Haven, Lock 1	62.5°	83.4°	73.0°	43.1°
Okeechobee, Gate 6	63.3°	81.4°	72.1°	NA
NA = Not Available				

occurs from 10 ft to 230 ft (3 m to 70 m) bls and consists of sand, limestone, and shell beds of the Pleistocene. The next layer of material is the Caloosahatchee Marl which occurs from 230 ft to 330 ft (70 m to 100 m) bls and is made up of shelly sands and shell marl of the Pliocene. Together, the Anastasia Formation and Caloosahatchee Marl comprise the water table or non-artesian aquifer of this region. Underlying these porous layers, there are a series of formations with lower permeability that act as a confining layer. The uppermost of these layers is the Tamiami Formation which occurs from 330 ft to 400 ft (100 m to 123 m) bls. The Tamiami formation is comprised of marly sand, marl, and shell beds of the Miocene. The Hawthorn Formation occurs from 400 ft to 890 ft (123 m to 271 m) bls, and is composed of clayey and sandy marl of the Miocene. The Tampa Formation exists from 890 ft to 940 ft (271 m to 287 m) bls, and is made up of limestone and some marl of the early Miocene. The Tampa Formation exhibits somewhat higher permeability yielding some artesian water.

The remaining known layers are composed of limestone and yield water under artesian conditions with sufficient pressure to flow to the surface. This principal artesian aquifer (Floridan Aquifer) underlies all of Florida and part of southeast Georgia. The layers of this aquifer are the Suwannee Limestone, Ocala Group, and Avon Park Limestone Formations that date back to the Oligocene, Late Eocene, and Late middle Eocene periods, respectively. While the Suwannee Limestone Formation occurs from 940 ft to 1000 ft (287 m to 305 m) bls, the remaining layers vary from 1000 ft (940 m) bls to undetermined depths.

In the Everglades region, the geological formation found at the surface is a thick covering of organic soils. These organic materials started accumulating

about 5,000 years ago and range in thickness from 3 ft to 10 ft (1 m to 3 m). The Fort Thompson formation occurs from 8 to 30 ft (2.4 m to 9 m) bls, and is composed of marine and fresh-water sands, marls, limestone, and shell beds of the Pleistocene.

The organic layer and the Fort Thompson Formation of the Everglades region are found in place of the Pamlico Sand and Anastasia Formations of the flatlands. Below these strata, the series of occurrence, composition, and permeability corresponds between the two regions, differing only in relative depths bls (Schroeder et al, 1954).

Reach One lies entirely within the Everglades region, of which, the geological framework is described above.

Soils

For general descriptive purposes, the soils found in the Lake Okeechobee region are grouped based on distinctive patterns of soils, relief, drainage, and natural landscape. There are three predominant soil groups in areas nearest to the HHD, each representing a distinct group of soil classes. These groups are referred to as (1) Soils of the Flatwoods, (2) Soils of Sloughs and Freshwater Marshes, and (3) Soils of the Everglades.

Soils of the Flatwoods are found at various points around Lake Okeechobee, and are especially predominant in the north. This group is made up of nearly level, poorly drained soils that are sandy throughout, and have organic staining in the subsoil.

The Soils of Sloughs and Freshwater Marshes are common throughout the Lake Okeechobee region. These soils are nearly level and very poorly drained. Most are organic with a sandy substratum, and some

have a thin organic surface layer and a loamy subsoil underlain by limestone.

Soils of the Everglades are nearly level and very poorly drained, and are primarily found along the south, southeastern, and southwestern portions of the lake. This group of soils has a surface layer of muck underlain by limestone.

Reach One occurs within the Soils of the Everglades group. Natural soils classes common within the Everglades group, and found in the vicinity of Reach One include; Torry muck, Adamsville sand-organic subsoil variant, Pahokee muck, and Terra Ceia muck (USDA, 1978). These are primarily moderately permeable soils with a water table within 3 ft (1 m) of ground surface.

No prime farmland soil classes are located in the vicinity of Reach One. However, the areas currently utilized for sugarcane production are classified as unique farmland soils based on use alone.

3.04 HYDROLOGY

Lake Okeechobee is a major hydrologic feature of south Florida and the Everglades ecosystem. It is also the primary reservoir of the Central and Southern Florida Flood Control Project. Lake Okeechobee receives water principally from rainfall and from the Kissimmee River, which enters the lake from Okeechobee County to the north. Smaller tributaries, including Fisheating Creek, Harney Pond Canal, Indian Prairie Canal, Taylor Creek, and lesser streams from small drainage basins adjacent to the lake contribute as well.

Because of Lake Okeechobee's large surface area, much of the surface water is lost to evaporation each year. Water is also released from the lake through the principal outfall canals including the West Palm Beach, Hillsboro, North New River, Miami, St. Lucie, and Caloosahatchee River Canals (Figure 11). The Caloosahatchee and St. Lucie canals are the primary outlets for release of floodwaters when the lake is above regulation stages (Lake Okeechobee Regulation Schedule, 1999).

Flow in the major drainage canals is generally from Lake Okeechobee toward the coasts. However, at times the flow in the canals is toward the lake owing to various combinations of concentrated rainfall and drainage pumping from farmlands into the canals. The groundwater throughout the Lake Okeechobee area is usually within 3.28 ft (1 m) of the land surface and extends to about 330 ft (100 m) bls. This water table generally parallels the land-surface features.

Differences in ground elevations are so slight that the water table is a relatively uniform surface with few undulations.

The principal source of recharge to the groundwater in this area is derived from local rainfall and by subsurface percolation from the canals into the permeable materials. Discharge from this shallow groundwater reservoir is by evaporation from the land or water surfaces, transpiration by plants, seepage into canals, and pumping from shallow wells. The groundwater flow typically follows a north to south gradient.

The major artesian aquifer underlying this region is the Floridan Aquifer, which occurs from about 1000 ft (300 m) bls to bedrock (Schroeder et al, 1954).

The hydrology within the area of Reach One is much the same as that described for the general area. It is likely, though, that because of the vast sugarcane plantations and saturated soil conditions along Reach One, evaporation and transpiration are responsible for an even greater amount of water loss. Major outfall canals along Reach One include the St. Lucie, West Palm Beach, and Hillsboro Canals.

3.05 WATER SUPPLY

The surface and groundwater in the Lake Okeechobee area provide a valuable source of water for public, domestic, industrial, and agricultural use for much of Southeast Florida. Additionally, significant natural areas located in the region receive water from this source as well.

Lake Okeechobee serves as a source of public water supply for Canal Point, Clewiston, Belle Glade, Okeechobee, Pahokee, and South Bay. Local industries such as sugarcane refineries and produce packaging/distribution centers also employ the available groundwater and surface water for their plant operations.

The City of Fort Myers depends upon Lake Okeechobee to ensure the quantity and quality of the supply of drinking water it withdraws from the Caloosahatchee River. Maintenance of minimum flows and levels within the downstream natural system also place additional demands on the lake. Urban demands are also expected to steadily increase.

Although the current regulation schedule of Lake Okeechobee was designed primarily to provide drainage, flood control and water supply benefits, the single largest demand on the lake is to provide water for agricultural irrigation. Agricultural activities

utilize the canals and culverts associated with Lake Okeechobee as a source of irrigation water for the many sugarcane and truck crops produced in the region. To the south and east of Lake Okeechobee, and adjacent to much of Reach One, the Everglades Agricultural Area (EAA) is one of the most productive farming regions in the country. The EAA relies heavily on water obtained from this resource, notably so along Reach One.

Lake Okeechobee provides water to several natural areas in the region. The Everglades, located south of the lake, receives a vital allotment of its annual water requirements directly from Lake Okeechobee and canals along its southern portion. To the south and southeast, there are three Water Conservation Areas (WCA) that receive water from Lake Okeechobee and serve as functional wetlands and municipal water supply.

Located in southeast Palm Beach County, WCA-1 (Arthur R. Marshall Loxahatchee National Wildlife Refuge), receives water from the West Palm Beach, and Hillsboro Canals that originate from Reach One of the HHD. Located in southeast Palm Beach County and northern Broward County, WCA-2 (part of the Everglades Wildlife Management Area), receives water from the Hillsboro, and North New River Canals also originating from Reach One of the HHD. Located in Broward County, WCA No. 3, receives water from the Miami Canal which originates from the HHD west of South Bay (Figure 11).

The WCAs are viable wetland environments and also provide water supply storage for the southeast coast. Additionally, water from WCA-3 is discharged to the sloughs and wetlands of Everglades National Park (Fernald and Patton, 1984).

Water released from two of the major outfall canals provides inflow to coastal estuarine ecosystems. The Caloosahatchee (C-43) Canal feeds the Caloosahatchee River Estuary on Florida's west coast, while the St. Lucie Canal feeds the estuaries associated with the St. Lucie Inlet on the east coast.

3.06 WATER QUALITY

Lake Okeechobee is considered a naturally eutrophic water body that is tending to become hypereutrophic, due primarily from nutrient inputs from the Kissimmee River and the Taylor Creek basins. Water quality conditions in the upper Kissimmee River appear to be improving, primarily due to re-routing of wastewater flows from the river to reuse and ground-water discharge sites. However, large

quantities of nutrients are still discharged from Lake Toho to Lake Kissimmee and other downstream areas. Water quality improves from Lake Kissimmee to near Lake Okeechobee, where the channel flows mostly through unimproved rangeland; however, pollutant loadings increase as cattle and dairies grow more numerous near the lake. Because the lake's phosphorus is internally recycled and a vast reservoir of the nutrient is stored in the lake sediments as well as wetland and canal sediments, phosphorus within the lake may not reach acceptable levels for many decades or even a century.

According to the 1996 305(b) report (FDEP, 1996) for Lake Okeechobee, the major pollution sources for the lake include runoff from ranch and dairy operations in the north where pollution has elevated phosphorus and coliform bacteria concentrations and created a large algal bloom. In the south, historic backpumping of runoff from row crops and sugar cane has elevated nutrient and pesticide levels. The backpumping has mostly ceased but still occurs when water in the primary canal of the EAA reaches 13 feet (flood-control levels). As a result, depending on location and seasonal rainfall or drought, the lake receives varying amounts of nutrients, substances creating high biological oxygen demand (BOD), bacteria, and toxic materials. Other pollutants include high levels of total dissolved solids, unionized ammonia, chloride, and dissolved organic chemicals.

Biological sampling indicates variable but generally eutrophic conditions. Widespread algal blooms and resulting fish kills have launched the environmental community and governmental agencies to investigate and analyze the lake's problems. The Lake Okeechobee Technical Advisory Committee, formed to assess the situation and recommend solutions, determined that phosphorus from dairies and agriculture were a major cause of the noxious algal blooms and that levels should be reduced by 40 percent. A few others contended that the secondary cause of increased phosphorus is the flooding of hundreds of acres of perimeter wetlands after the SFWMD decided in the late 1970's to raise the lake's water level. The higher level also reduced valuable fish-spawning grounds and waterfowl feeding and nesting habitat.

In general, the water quality trends for the lake are stable at six sites, improved at two sites, and degraded at two sites. The best water quality observations were noted for the flow entering Fisheating Creek and along the west near wetlands, while the worst water quality conditions occurred in

the south by agricultural areas, and to the northeast by Taylor Creek, Nubbin Slough and the St. Lucie Canal. The reported major pollution sources in this basin were dairies and agriculture. A generalized assessment of the lake shows the lake as having fair water quality conditions, except for Myrtle Slough which was shown to have poor water quality, and the extreme south-southwest section of the lake where good water quality conditions are described by the 305(b) report (FDEP, 1996).

3.07 WATER MANAGEMENT

Lake Okeechobee is the primary reservoir of the Central and Southern Florida Flood Control Project. The lake is capable of storing 2.7 million acre-feet of water between stages of 10.5 ft (3.2 m) NGVD and the top of the regulation schedule at 17.5 ft (5.3 m) NGVD.

The lake is regulated for multiple-use purposes such as flood control, water supply, regional groundwater control, enhancement of fish and wildlife, navigation and recreation. The guidelines for the management of lake water levels are a regulation schedule that was developed by the SFWMD and the Corps. The schedule was developed to provide seasonal lake fluctuations that attempt to lower the lake stage prior to the wet season to provide both storage capacity and flood protection for the surrounding areas during the wet season. After the peak of the hurricane season, lake levels are allowed to increase to store water for the upcoming dry season. The Caloosahatchee River and the St. Lucie Canal are the primary outlets for release of floodwater when the lake is above regulation stages. The Corps is ultimately responsible for prescribing regulations and key operating criteria for all project works. Any operational activity must be consistent with the Corps' water management plan. (See Appendix I, Hydrology and Hydraulics analysis, Herbert Hoover Dike Major Rehabilitation Evaluation Report, December 1998, for information on the frequency of lake levels and how they were determined.)

A series of structures are situated around Lake Okeechobee that provide flood protection, control drainage, and facilitate navigation (Figure 11). The Corps operates the primary structures and navigation locks around the lake and is responsible for maintenance of the schedule. The SFWMD operates and maintains the secondary water control structures and pump stations.

Present drainage operations and the regulation of the water stages of Lake Okeechobee have produced a complex water-table pattern in the region. The

resistance of peat to lateral groundwater seepage and the relatively impervious character of the marl, which overlies the shallow permeable water-bearing rocks, make water control economically feasible in this area (Shroeder et al, 1954).

Since the Reach One area has very little natural drainage, it therefore depends on large pump stations to prevent floods from heavy rains. Pumps remove excess water from the Everglades Agricultural Area and pump this water into Lake Okeechobee during wet months and release water from the lake for irrigation during the dry growing season (Fernald and Patton, 1984).

Along Reach One, there are eight gated culverts, two hurricane gate structures, and one lock (Figure 11). Control of waters from these structures is primarily the responsibility of the Corps and SFWMD. However, eight private drainage districts assume control of water flow within the region of Reach One. These are: 1) Mayaca Groves, 2) Palm Beach Groves, 3) Cloister Farms, 4) U.S. Sugar Corporation, 5) East Beach Drainage District, 6) Pahokee (or 715) Farms, 7) East Shore Drainage District, and 8) South Shore Drainage District.

Under Chapter 373 of the Florida Statutes, Water Management Districts are directed to implement several provisions for water resource protection. The statutes require that surface waters be managed in such a way as to prevent significant harm to the natural resources, including fish and wildlife, and that they lay out tools that may be used to regulate water use. One of the management tools specifically referred to in the statutes is Minimum Water Level (MWL), defined as "the level of groundwater in an aquifer and the level of surface water at which further withdrawals would be significantly harmful to the water resources of the area." The statute further specifies that the minimum levels be established using "best available information" and that they be established within a "reasonable" time period.

The Lake Okeechobee MWL criteria include three components: (1) minimum depth - a lake water level that, if sustained for a defined period of time, would result in harm to the resource; (2) duration - the estimated period of time that water levels can remain below the specified minimum depth without causing harm to the resource; and (3) return frequency - the frequency of occurrence for events wherein water levels may recede below the minimum depth without causing harm to the resource. The criteria were established in reference to the littoral marsh zone of the lake, a large region (about 20% of the total lake

area) of emergent vegetation along the south and west edges of the lake. This region of the lake is the principal spawning area for commercial and recreational fishes, feeding and nesting area for wading birds, and critical habitat for other wildlife, including the American alligator and the endangered snail kite.

Minimum depth criteria were established based on Geographic Information System data regarding littoral zone inundation and drying under different water regimes, information on vegetation spatial distribution, bird and fish use of different vegetation types, and relationships between depth and recreational use of the water resource. Two criteria were established; 11 and 12 ft (3.4 m and 3.7 m) NGVD, each with a specified duration and return frequency. For return frequency, not more than one time every 7 years below 11 ft NGVD, and not more than one time every 3 years below 12 ft NGVD; and for duration, not to exceed the MWL of 11 ft NGVD for longer than 120 days per event, nor the 12 ft NGVD criterion for longer than 180 days per event.

To fully protect the ecosystem from harm, it also is critical that water levels be established at the other extreme, i.e., for the maxima that occur during prolonged high water periods. Evidence indicates that those events may be just as harmful to the ecosystem as prolonged lows (Havens, 1998). Prolonged submersion may damage or eliminate emergent vegetation communities and associated wildlife habitat. This also reduces Lake Okeechobee's ability to act as a nursery for aquatic organisms (U.S. Department of the Interior, 1997).

3.08 VEGETATION AND COVER TYPES

The vegetation and cover types within the Lake Okeechobee region have been greatly altered during the last century. Historically, the natural vegetation was a mix of freshwater marshes, hardwood swamps, cypress swamps, and pine flatwoods. The freshwater marshes were the predominant cover type throughout, but especially along the southern portion of the lake where it flowed into the Everglades. These marshes were vegetated primarily with sawgrass (*Cladium jamaicense*) and scattered clumps of Carolina willow (*Salix caroliniana*), sweetbay (*Magnolia virginiana*), and cypress (*Taxodium* spp.). Hardwood swamps dominated by red maple (*Acer rubrum*), sweetbay, and sweet gum (*Liquidambar styraciflua*) occurred in riverine areas feeding the lake, while cypress swamps composed mostly of cypress were found in depressional areas throughout the region. Pine flatwoods composed of slash pine (*Pinus elliottii*), cabbage palm (*Sabal palmetto*), and saw palmetto

(*Serenoa repens*) were prevalent in upland areas especially to the north. Although some of these natural areas still exist, the introduction of controlled drainage for agriculture and land development has resulted in a significantly different set of cover types.

Landward of HHD

Landward of the entire HHD, sugarcane plantations, improved pasture, row crops, and urban lands now prevail. The HHD itself is covered with mixed grasses that are mowed on a regular basis.

On the landward side of Reach One, the predominant cover types within 500 ft (150 m) of the dike are urban and agricultural. The city of Pahokee constitutes the urban component that occupies approximately 40% of this area. Residences and businesses within the city of Pahokee often abut the very toe of the HHD. Sugarcane, row crops, and other agricultural areas account for approximately 40% of this area as well. Some of these agricultural areas, especially sugarcane in the southern portion of Reach One, also border the toe of the HHD. Significant cover types occupying the remainder of this area include small isolated wetlands (see Section 3.09), patches of nuisance vegetation, and a series of limestone quarries.

Beyond 500 ft (150 m) from the HHD, the major cover type along Reach One is agricultural. Sugarcane is the primary crop, with some ornamental groves and row crops. The city of Belle Glade, resides approximately 1.5 mile (2.4 km) southeast of Reach One, comprising a significant urban component in this range.

Waterward of HHD

The major cover types on the waterward side of Reach One include open water, spoil islands, freshwater marshes, agriculture, and urban. Naturally, open water represents the greatest portion of the area. Spoil islands also occur along Reach One, and are especially prevalent along the central and southern portion of the Reach. These islands are not naturally occurring, rather they are narrow strips of dredged material about 16.4 ft (5 m) wide and are approximately 100 ft (30 m) away from the toe of the HHD. These materials were dredged during creation/maintenance of the rim canal. Tree species existing on these narrow islands are mostly nuisance species such as Australian pine (*Casuarina* sp.), melaleuca (*Melaleuca quinquenervia*), and Brazilian pepper (*Schinus terebinthifolius*).

Freshwater marshes occur waterward of Reach One in the low lying areas skirting Kreamer and Torry

Islands (Figure 10) which are near the southern end of the Reach. Vegetation in these areas includes sawgrass, Brazilian pepper, and cabbage palms. Agriculture, primarily sugarcane, occurs on Kreamer and Torry Islands, too, occupying several hundred hectares (over 1,000 acres) of land.

The urban component of land cover waterward of Reach One is a small residential area on the southern end of Torry Island.

Exotic and Nuisance Vegetation

Exotic and nuisance vegetation is found all along Reach One. In the northern portion, there is strip of land between the HHD and a transportation corridor (Hwy. 98/441 and the Florida East Coast Railroad) in which many exotics are present. A mixture of melaleuca, Australian pine, and Brazilian pepper is found in this strip of land. In the drainage ditches along the toe of the dike, nuisance vegetation exists including species such as water hyacinth (*Eichhornia crassipes*) water lettuce (*Pistia stratiotes*), hydrilla (*Hydrilla verticillata*), cattails (*Typha sp.*), and bamboo (*Arundinaria sp.*).

Limestone Quarries

A series of limestone quarries are located immediately south of Culvert C-12, in the southern portion of Reach One (Figure 10). These quarries are found immediately at the toe of the HHD and are approximately 3,000 ft (900 m) long. Due to the steep cut of the quarries, no littoral zone vegetation exists. However, some vegetation such as Carolina willow, and Brazilian pepper is found along the very edge where mowers do not reach.

3.09 WETLANDS

Wetlands in the Lake Okeechobee area, though greatly reduced through human impacts, still exist as functional ecotypes. These wetlands represent an important set of valuable and productive ecosystems both landward and waterward of the HHD. Lake Okeechobee supports important wetlands beyond the immediate area by providing them with a source of water. The Florida Everglades to the south, and Water Conservation Areas in Palm Beach and Broward Counties (see Section 3.05) are all recipients of freshwater derived from the lake.

In the area of Reach One, there are fewer outstanding wetland areas relative to the remainder of the lake. In this area, the large-scale drainage efforts for agriculture and development have perhaps had the most apparent impact.

Landward of HHD

Landward of the HHD, notable wetland types are found in both riparian and isolated depressional areas. In proximity to the HHD, the lower Kissimmee River, Fisheating Creek, Taylor Creek, and Nubbin Slough represent riparian areas supporting viable freshwater marshes as these streams meander into the lake area. These areas are utilized by a wide variety of wildlife as foraging and nesting habitats. Isolated depressional wetlands in the area also provide an important and often diverse source of habitat as well.

On the landward side of Reach One, remaining wetlands are typically found along ditches or low lying areas and are usually a result of impoundment rather than natural hydrology. The majority of these are small, isolated freshwater wetlands located in the northern portion of Reach One within the strip of land between the HHD and the transportation corridor (Hwy. 98/441 and the Florida East Coast Railroad). Typical vegetation in these wetlands includes Carolina willow, water hyacinth, cattails, water lettuce, and duckweed (*Lemna sp.*). Along the toe ditch of the HHD, there are a number of places where impoundment of water also occurs. These impoundments are typically small areas occupying less than one hectare (2.47 acre) and host a similar set of hydrophilic vegetation.

Although wetlands present on the landward side of Reach One may not be considered high quality ecosystems, they do host small fishes and invertebrates and provide usable foraging habitat for wading birds, alligators, and turtles.

Waterward of HHD

Waterward of the HHD, large freshwater marshes exist in the shallow littoral zones of Lake Okeechobee. These are high quality herbaceous wetlands dominated by sawgrass, bulrushes (*Scirpus sp.*), cattails, eel-grass (*Vallisneria sp.*), and hydrilla. These marshes are important habitats for a diverse population of invertebrates and fish, which are, in turn, a food source for other fish, birds, amphibians, reptiles, and mammals, including humans. These marshes are sensitive to prolonged low water levels, prolonged high water levels, and invasion by exotic species. The larger of these occur where streams enter the lake providing silt and nutrients. Foremost among the large freshwater marshes is the 150 square mile (400 km²) marsh on the western shores of the lake.

Waterward of Reach One, there are few wetland areas immediately adjacent to the HHD. Due to

dredging activities for the rim canal which parallels the HHD, the littoral zone is narrower than that found in some of the remaining reaches. The water depth increases rapidly here, providing less habitat, but wading birds are still frequently seen foraging at the toe of the dike.

Large freshwater marshes are still found waterward of Reach One, primarily around Kreamer and Torry Islands. Located near the southern extent of Reach One, these freshwater marshes are diverse, high quality herbaceous wetlands dominated by sawgrass, bulrushes, cattails, eel-grass, and hydrilla. These marshes provide over 1,000 acres (several hundred hectares) of valuable habitat for a diverse population of invertebrates and fish, which are, in turn, a food source for other fish, birds, amphibians, reptiles, and mammals, including humans. These marshes are sensitive to prolonged low water levels, prolonged high water levels, and invasion by exotic species.

3.10 FISH AND WILDLIFE

Fish and wildlife species present in the Lake Okeechobee area, though surely fewer now than a century ago, are still quite numerous and utilize the many natural areas around the lake.

Fish

The aquatic habitats of Lake Okeechobee and the freshwater marshes on both the waterward and landward sides of the HHD provide important habitat for a variety of fish. Within the lake, significant populations of fish such as large mouth bass (*Micropterus salmoides*), catfish (*Ictalurus* spp.) black crappie (*Pomoxis nigromaculatus*), sunshine bass (*Morone chrysops*), redear sunfish (shellcracker) (*Lepomis microlophus*), threadfin shad (*Doromosa petense*), and bluegill (*L. macrochirus*) exist (FGFWFC, 1997). The waterward freshwater marshes provide important nursery grounds for these fish and many others. The landward freshwater marshes and ditches provide habitat for numerous smaller fishes. Many of these fishes provide food for amphibians, reptiles, birds, and mammals, including humans.

Amphibians

Important habitat for a variety of amphibians is provided by the aquatic habitats of Lake Okeechobee and the freshwater marshes on both the waterward and landward sides of the HHD. Bullfrog (*Rana catesbeiana*), and southern leopard frog (*R. utricularia*) utilize these habitats throughout their life cycles. Terrestrial amphibians such as southern toad (*Bufo terrestris*), green treefrog (*Hyla cinerea*), dwarf salamander (*Eurycea quadridigitata*), and Everglades

dwarf siren (*Pseudobranchius striatus belli*) breed and live their early life stages here. These animals provide a food source for other animals such as fish, birds, reptiles, and mammals (Cowley, 1998).

Reptiles

A variety of reptile species are found within the aquatic habitats of Lake Okeechobee and the freshwater marshes on both the waterward and landward sides of the HHD. Among these are the American alligator (*Alligator mississippiensis*), Florida mud turtle (*Kinosternon subrubrum steindachneri*), common musk turtle (*Sternotherus odoratus*), peninsula cooter (*Pseudemys florida peninsularis*), Florida snapping turtle (*Chelydra serpentina osceola*), Florida softshell turtle (*Apelone ferox*), Florida water snake (*Nerodia fasciata pictiventris*), and Florida cottonmouth (*Agkistrodon piscivorus conanti*). Additionally, green anole (*Anolis carolinensis*), and Cuban anole (*A. sagrei s.*) may be found in the vegetation bordering these habitats (Cowley, 1998). These animals provide a food source for other animals such as fish, birds, amphibians, other reptiles, and mammals.

Birds

The habitats within and surrounding Lake Okeechobee are frequented by a number of bird species. Birds of prey such as bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandionion haliaetus*), snail kite (*Rostrhamus sociabilis plumbeus*), and northern harrier (*Circus cyaneus*) commonly utilize these areas. Wading birds such as great blue heron (*Ardea herodias*), great egret (*Casmerodius albus*), little blue heron (*Egretta caerulea*), snowy egret (*E. Thula*), tri-colored heron (*E. tricolor*), and wood stork (*Mycteria americana*) are seen in relatively large numbers within the aquatic habitats of the lake and the freshwater marshes on both the waterward and landward sides of the HHD. Other birds commonly utilizing the area include anhinga (*Anhinga anhinga*), double-crested cormorant (*Phalacrocorax auritus*), and black skimmer (*Rynchops niger*) (Cowley, 1998). Additionally the habitats of Lake Okeechobee and the surrounding area provide cover and foraging habitat for migratory waterfowl such as ring-necked duck (*Aythya collaris*), canvasback (*A. valisineria*), and lesser scaup (*A. affinis*) as well as a multitude of neotropical migrants.

Mammals

The aquatic habitats of Lake Okeechobee and the freshwater marshes on both the waterward and landward sides of the HHD provide important habitat for a variety of mammals. Animals such as raccoon (*Procyon lotor*), river otter (*Lutra canadensis*),

striped skunk (*Mephitis mephitis*), marsh rabbit (*Sylvilagus palustris*), and nine-banded armadillo (*Dasypus novemcinctus*) range throughout this area (Cowley, 1998). The Florida manatee (*Trichechus manatus latirostris*) is also known to utilize the lake and its waterways.

Invertebrates

An important array of invertebrates exists within Lake Okeechobee and associated habitats. These animals provide an important food base for many fish, amphibians, reptiles, birds and mammals. Apple snail (*Pomacea paludosa*), common especially in the freshwater marshes, is the sole food source for the endangered snail kite. Other epiphytic snails are common throughout the waters as well. Insect larvae are particularly prevalent throughout the aquatic habitats of the lake and the freshwater marshes on both the waterward and landward sides of the HHD. Among these are water fleas (*Chydorus sphaericus*), mayflies (*Ephemeroptera* spp.), dragonflies and damselflies (Order Odonata), and mosquitoes (Order Diptera).

Along Reach One, the potential for fish and wildlife is somewhat reduced. The landward side of the dike is dominated by urban and agricultural property. As a result, there is little continuous habitat available for many wildlife species. Waterward, due to the dredged conditions of the rim canal, the littoral zone is narrower than would naturally occur, providing less than optimal wildlife habitat. Even with the less than ideal conditions, wading birds are commonly observed on the landward and waterward sides of the HHD, which indicates a viable population of small fishes and invertebrates along either toe of the dike.

3.11 THREATENED AND ENDANGERED SPECIES

Fauna

Although ideal habitat conditions no longer exist for wildlife in the area of Reach One, listed faunal species are still observed in this area. The USFWS has determined that five listed faunal species occur in the vicinity of Reach One and could be affected by the proposed project. These species include the Eastern indigo snake, American bald eagle, wood stork, Everglade snail kite, and West Indian manatee. The western shore of Lake Okeechobee, including the entire littoral zone, is designated as critical habitat for the Everglade snail kite. This includes the marshes located along the segment of the lake from the Hurricane Gate at Clewiston to the mouth of the Kissimmee River. The USFWS has further determined that although critical habitat has been

designated for the West Indian manatee in certain Florida waters, the waters of Lake Okeechobee are not included in that designation (USFWS, February 1996).

The Florida Natural Areas Inventory (FNAI) has records of observations for five listed faunal species within one mile (1.6 km) of Reach One. These include the American alligator, eastern indigo snake, bald eagle, wood stork, and West Indian manatee (FNAI, 1998). Although this may not be a complete representation of listed species utilizing this area, the FNAI provides the best reliable database for listed species incidence in Florida.

In addition to species listed by the USFWS and the FNAI, three additional listed species were observed along Reach One during the site survey for this report. Each of these species are birds seen foraging along the toe ditches or at the edge of the lake. These were the brown pelican, little blue heron and tri-colored heron, each of which is listed as a species of special concern by the FFWCC.

A description of each species reported by the USFWS and the FNAI follows.

American Alligator

Alligator mississippiensis

The American alligator's range extends across the southeastern states of Alabama, Arkansas, North & South Carolina, Florida, Georgia, Louisiana, Mississippi, Oklahoma, and Texas (University of Florida, 1998).

This reptile utilizes freshwater swamps and marshes as its primary habitat, but is also seen in rivers, lakes and smaller bodies of water. Alligators have been shown to be an important part of their ecosystem, and are thus regarded by many as a "keystone" species. This encompasses many areas from control of prey species to the creation of peat through their nesting activities (University of Florida, 1998).

Populations of the American alligator were severely affected in the early parts of this century, due to hunting of the animal for its skin. In 1967, this species was listed as an endangered species that prohibited alligator hunting. As a result, the alligator has undergone a successful recovery. Alligator hunting is allowed again; however, permits are issued by lottery only during alligator hunting season.

TABLE 2
LISTED FAUNAL SPECIES
OCCURRING IN MARTIN & PALM BEACH COUNTIES, FLORIDA
(FNAI, 1998)

Scientific Name	Common Name	Federal Status ¹	State Status ²
AMPHIBIANS			
<i>Rana capito</i>	gopher frog		S
REPTILES			
<i>Alligator mississippiensis</i>	American alligator	T/SA	S
<i>Caretta caretta</i>	Loggerhead	T	T
<i>Chelonia mydas</i>	green turtle	E	E
<i>Dermochelys coriacea</i>	Leatherback	E	E
<i>Drymarchon corais couperi</i>	eastern indigo snake	T	T
<i>Eretmochelys imbricata</i>	Hawksbill	E	E
<i>Gopherus polyphemus</i>	gopher tortoise		S
<i>Lepidochelys kempii</i>	Atlantic ridley	E	E
<i>Pituophis melanoleucus mugitus</i>	Florida pine snake		S
BIRDS			
<i>Ajaia ajaja</i>	roseate spoonbill		S
<i>Aramus guarana</i>	Limpkin		S
<i>Aphelocoma coerulescens c.</i>	Florida scrub jay	T	T
<i>Caracara plancus</i>	crested caracara	T	T
<i>Egretta caerulea</i>	little blue heron		S
<i>Egretta rufescens</i>	reddish egret		S
<i>Egretta thula</i>	snowy egret		S
<i>Egretta tricolor</i>	tricolored heron		S
<i>Eudocimus albus</i>	White ibis		S
<i>Falco peregrinus</i>	peregrine falcon		E
<i>Grus canadensis pratensis</i>	Florida sandhill crane		T
<i>Haliaeetus leucocephalus</i>	Bald eagle	T	T
<i>Mycteria americana</i>	wood stork	E	E
<i>Pelecanus occidentalis</i>	brown pelican		S
<i>Picoides borealis</i>	red-cockaded woodpecker	E	T
<i>Rostrhamus sociabilis plumbeus</i>	snail kite	E	E
<i>Speotyto cunicularia floridana</i>	Florida burrowing owl		S
<i>Sterna antillarum</i>	least tern		T
MAMMALS			
<i>Felis concolor coryi</i>	Florida panther	E	E
<i>Podomys floridanus</i>	Florida mouse		S
<i>Sciurus niger shermani</i>	Sherman's fox squirrel		S
<i>Trichechus manatus</i>	West Indian manatee	E	E

¹Federal Legal Status (US Fish and Wildlife Service)

E = Endangered Species.

T = Threatened Species.

T/SA = Threatened due to similarity of appearance.

²State Legal Status (Florida Game and Fresh Water Fish Commission)

E = Endangered Species.

T = Threatened Species.

S = Species of Special Concern.

The occurrence of the American alligator along Reach One is likely on the waterward side of the HHD, as well as many portions of the landward side. In areas where development has occurred, such as Pahokee, it is unlikely.

The American alligator is currently listed as threatened by the USFWS, due to its similarity to the American crocodile (*Crocodylus acutus*). The American alligator is currently listed as a species of special concern by the FFWCC.

Eastern Indigo Snake

Drymarchon corais couperi

The eastern indigo snake is the largest non-venomous snake in North America. It is an isolated subspecies occurring in southeastern Georgia and throughout peninsular Florida.

The eastern indigo prefers drier habitats, but may be found in a variety of habitats from xeric sandhills, to cabbage palm hammocks, to hydric hardwood hammocks (Schaefer and Junkin, 1990).

Indigos need relatively large areas of undeveloped land to maintain population. The main reason for its decline is habitat loss to development. Further, as habitats become fragmented by roads, indigos become increasingly vulnerable to highway mortality as they travel through their large territories (Schaefer and Junkin, 1990).

The occurrence of the indigo along Reach One is possible along the HHD itself, and landward. However, this is not highly likely due to the isolation of the HHD from more ideal habitats.

The eastern indigo snake has been classified as a threatened species by the USFWS since 1978 and by the FFWCC since 1971.

Bald Eagle

Haliaeetus leucocephalus

The bald eagle is the only eagle unique to North America. It ranges over most of the continent, from the northern reaches of Alaska and Canada down to northern Mexico.

The bald eagle occurs in various habitats near lakes, large rivers and coastlines. In general, they need an environment of quiet isolation; tall, mature trees; clean waters; and prefer nesting within one-half mile (0.8 km) of water (USFWS, July 1995).

The bald eagle population was decimated in the 19th and early 20th centuries by habitat destruction,

hunting, pesticide use and lead poisoning. In 1967, bald eagles were officially declared an endangered species. Due to this and other protective measures, the population has made a tremendous comeback, its populations greatly improving in numbers, productivity, and security in recent years. Its strongest populations are currently found in Alaska and Florida (USFWS, July 1995).

It is believed that active bald eagle nests are in the vicinity of Reach One. Surveys will be conducted prior to any authorized construction activities. The bald eagle is currently listed as a threatened species by both the USFWS and FFWCC.

Wood Stork

Mycteria americana

The wood stork is the only stork occurring in the United States. In the U.S., the wood stork's range includes Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina, and Texas. The only states in which this bird is known to nest, however, are Florida, Georgia and South Carolina (Mazzotti, 1990).

Wood storks are wetland dwellers and use fresh, brackish and saltwater habitats for feeding and nesting. Feeding takes place in shallow ponds, tidal pools, swamps and marshes. Nesting occurs in cypress, hardwood and mangrove swamps. The extreme dependence of the wood stork on naturally functioning wetlands makes it an excellent indicator of the health of wetland ecosystems (Mazzotti, 1990).

Until the last few decades, the wood stork was a common sight in Florida wetlands. However, between the 1930's and 1960's, there was a serious decline in this species. One reason for the decline in population has been the changes in the hydrologic regime of the Everglades, which affected its foraging habitat and food production (Mazzotti, 1990). Utilization of habitats along Reach One by the wood stork for foraging is highly likely. It is unlikely, however, that this bird would utilize areas in proximity to Reach One for nesting purposes.

Wood storks are currently listed as an endangered species by both the USFWS and FFWCC.

Everglade Snail Kite

Rostrhamus sociabilis plumbeus

Although previously located in freshwater marshes over a considerable area of peninsular Florida, the range of the snail kite is currently more limited. This bird is now restricted to several impoundments on the headwaters of the St. John's River; the southwest side

of Lake Okeechobee; the eastern and southern portions of WCAs 1, 2A and 3; the southern portion of WCA 2B; the western edge of WCA 3B; and the northern portion of Everglades National Park (USFWS, May 1996).

The kite inhabits relatively open freshwater marshes which support adequate populations of apple snail, upon which this bird feeds almost exclusively. Favorable areas consist of extensive shallow, open water such as sloughs and flats, vegetated by sawgrass and spikerush (*Eleocharis* spp). The areas are often interspersed with tree islands or small groups of scattered shrubs and trees which serve as perching and nesting sites. The water level must be sufficiently stable to prevent loss of the food supply through drying out of the surface. The southwest shore of Lake Okeechobee from the Hurricane Gate at Clewiston to the Kissimmee River (excluding deep open water) is considered critical habitat for the snail kite (USFWS, May 1996).

The snail kite is threatened primarily by habitat loss and destruction. Widespread drainage has permanently lowered the water table in some areas. This drainage permitted development in areas that were once kite habitat. In addition to loss of habitat through drainage, large areas of marsh are heavily infested with water hyacinth which inhibits the kite's ability to see its prey (USFWS, May 1996). The utilization of waters along Reach One by the snail kite is not likely common, for the waters are typically too deep here for the apple snail. The primary area of concern in Lake Okeechobee is along its southwestern shore.

The snail kite is currently listed as an endangered species by both the USFWS and FFWCC.

West Indian Manatee

Trichechus manatus

The West Indian manatee, or sea cow, is a large, plant-eating aquatic mammal that can be found in the shallow coastal water, rivers, and springs of Florida. Florida is essentially the northern extent of the West Indian manatee's range, though some manatees occasionally are reported from as far north as Virginia and the Carolinas (FP&L, 1989).

The West Indian manatee lives in freshwater, brackish, and marine habitats, and can move freely between salinity extremes. It can be found in both clear and muddy water. Water depths of at least 3 to 7 ft (1 to 2 m) are preferred and flats and shallows are avoided unless adjacent to deeper water. During the summer months, manatees range throughout the

coastal waters, estuaries, bays, and rivers of both coasts of Florida and are usually found in small groups. During the winter, manatees tend to congregate in warm springs, and outfall canals associated with electric generation facilities (FP&L, 1989).

Over the past centuries, the principal sources of manatee mortality have been opportunistic hunting by man and deaths associated with unusually cold winters. Today, poaching is rare, but high mortality rates from human-related sources threaten the future of the species. The largest single mortality factor is collision with boats and barges. Manatees also are killed in flood gates and canal locks, by entanglement or ingestion of fishing gear, and through loss of habitat and pollution (FP&L, 1989).

The utilization of Lake Okeechobee by the West Indian manatee is not uncommon. The potential for this animal to occur in the waters immediately adjacent to Reach One of the HHD for feeding is reduced due to the relatively low presence of littoral zone vegetation. The manatee may however, utilize this area for travel and other behaviors.

The West Indian manatee is currently listed as an endangered species by both the USFWS and FFWCC.

Flora

Although normal vegetative conditions no longer exist in the area of Reach One, one listed floral species is still observed in this area. The USFWS has determined that the Okeechobee gourd is likely to occur in the area of Reach One (USFWS, February 1996) (FNAI, 1998). A description of the Okeechobee gourd follows.

Okeechobee Gourd

Curbita okeechobeensis o.

The Okeechobee gourd is a fibrous-rooted, high-climbing vine with tendrils. Its leaf blades are heart-to kidney-shaped with five to seven shallow, angular lobes and irregularly serrated margins. This plant occurs only along the shores of Lake Okeechobee and the St. John's River (USFWS, February, 1997).

The Okeechobee gourd is usually found in pond apple (*Annona glabra*) hammocks, heavily tangled woods, and willow (*Salix* spp.) and elderberry (*Sambucus canadensis*) thickets. The seeds of this gourd germinate on bare, exposed muck and especially on alligator nests where the soil has been disturbed (USFWS, February 1997).

By 1930 at Lake Okeechobee, about 95% of the pond apple forests that had probably been occupied by this gourd were destroyed for agricultural purposes. At that time the gourd was still locally abundant, but since then it has become rare and difficult to find around the lake (USFWS, February 1997).

An Okeechobee gourd survey conducted in 1990-1991 found a total of 11 sites along the southeastern shore of Lake Okeechobee (USFWS, 1998). The specific location of known plant locations is sensitive information, so discussion within this text is restricted (FNAI, 1998).

The Okeechobee gourd is currently listed as an endangered species by the USFWS and the FFWCC.

3.12 NOISE

Along Reach One there are a number of existing sources currently contributing to the overall ambient noise level. The more predominant of these sources include:

- vehicular traffic traveling along nearby highways;
- railroad traffic along the Florida East Coast Railway;
- single engine aircraft utilizing the Pahokee Airport;
- small industry (i.e., produce processing and distribution);
- boat traffic along the rim canal;
- urban activities in Pahokee and Belle Glade;
- agricultural equipment (tractors, trucks, etc.); and
- pumping stations.

Rural areas typically have noise levels of 35-55 db. Sound levels along transportation arteries are typically in the range of 70 dB.

3.13 AIR QUALITY

Existing air quality in the affected environment is good to moderate. Over 90 percent of the project area is in Palm Beach County with only a small portion located in Martin County. This project is in an area which has been designated by the Clean Air Act as a Prevention of Significant Deterioration (PSD) Class II area for U.S. Environmental Protection Agency (EPA) regulated air pollutants except ground level ozone. All of Palm Beach County is classified by the FDEP as an Ozone Attainment/Maintenance Area. This project would not be subject to any PSD incremental requirements for these pollutants since the project would fall under

the fugitive emissions exemption, as per Rule FAC 62-212.400(a)(b).

In the area of Reach One, there are a number of existing sources that may affect air quality in the project area. Registered stationary emission sources include thirty stationary air point sources located in Martin County, and close to two hundred stationary air sources in Palm Beach County (FDEP, 1998). Notable registered sources near Reach One include the local sugar processing plants. Namely, the Atlantic Sugar Association plant near Belle Glade, and the U.S. Sugar Corporation plant near Clewiston each contribute to the overall air quality of this area.

In the area of Reach One, the prevailing southeast and east-northeast winds may carry vehicle emissions from US 98/441, State Road 715, and the Florida East Coast Railroad. Although these mobile source emissions are not significant, they do currently contribute to the air quality in the area.

Additionally, short-term occurrences of elevated levels of airborne particulate matter may occur periodically from natural fires, controlled burns, and other sources. The potentially unaccounted for volatile organic compound emissions coming from nearby agricultural activities may contribute to the existing air quality as well.

3.14 HAZARDOUS, TOXIC AND RADIOACTIVE WASTES

Several site visits were conducted with the most recent Hazardous, Toxic and Radioactive Waste (HTRW) survey having been performed on 12 August 1998. The HTRW database, aerial photography review and site assessment of the existing conditions found the potential of HTRW contamination. The immediate property surrounding Lake Okeechobee consists of the Herbert Hoover Dike, which was free of discolored soil or stressed vegetation, or any other indicator that may indicate contamination levels requiring clean-up on the dike. However, close to the dike, several locations have the potential of being a source of contamination. In the municipality of Pahokee, on the east end of the lake, businesses and private residences approach very close to the back toe of the HHD. It appears that the dike has been used as the "backyard fence". In some instances, private residences have installed a property fence creating a secure backyard boundary, the dike. This may have caused residents in the neighborhood to store materials close to the dike. Although no obvious contamination was observed, the potential of having past spills in these areas does exist. The physical inspection was performed by random spot

check and driving along the road in the vicinity of the dike. It should be noted that rainfall and the high seepage rates in the area would have flushed-out most hydrocarbon, or smaller molecule chemical spills. Large molecule (PCB's), and metals may be less mobile and these spills may still measure residual levels. During real estate procurement and project construction, further evaluations would be required. The perimeter road has several leaking underground storage tanks and there have been several reported spills around Lake Okeechobee. All of these potential contamination problems are located within towns or along the highways that runs very close to the dike.

3.15 LAND USE

The existing land uses in the Reach One area, including elements such as agriculture, urban land, transportation, transmission lines, communication, and quarries, is discussed and depicted in Figure 7 and the following text. Figures 8, 9, & 10 enlarge Reach One into three sections (Sub-Reach 1A, 1B, & 1C, respectively) for better representation of these components.

Agriculture

The primary land use in the Lake Okeechobee region is agriculture. Major agricultural activities in the area include sugarcane plantations, cattle ranching, dairy farming, ornamental nurseries, vegetable production, and citrus groves. Farmland within the counties that surround Lake Okeechobee (Glades, Hendry, Martin, Okeechobee, and Palm Beach) occupies from 50 to 76% of the total land area (Purdum, 1994).

Throughout the Lake Okeechobee area, agricultural activities frequently occur very near the landward toe of the HHD. Agricultural utilization of the land immediately adjacent to the HHD is especially predominant in the south and southeast where the soil is higher in organics, thus more valuable for crop production. Cattle ranching, common to the north of the lake, is present in near proximity to the HHD as well.

Along Reach One, agricultural land use is especially common immediately adjacent to the HHD. Along the southern third of Reach One, sugarcane plantations occupy the lands right up to the toe ditch. Further agricultural activities in close proximity to the HHD include ornamental nurseries and row crops in the northern portion of Reach One which occur at the very toe of the HHD as well.

Other common land use types in the Lake Okeechobee region are frequently associated with

agriculture. Sugarcane refineries, produce packaging and shipping plants, and other support activities constitute a significant land use along with direct agriculture.

Urban Land

Another significant use of the lands in this region is urban development. Six incorporated communities are situated around the lake and range in population from approximately 1,400 to 16,000 (Table 3). Each of these communities is partially or completely within 1 mile (1.6 km) of the HHD.

Along Reach One, the city of Pahokee and Belle Glade are in close proximity to the HHD. Pahokee parallels the HHD for over 5 miles (8 km) along the central portion of Reach One. All along this stretch, there are places where residences, businesses, and municipalities occur within 100 ft (30 m) of the HHD. Belle Glade occurs in the southern portion of Reach One, and also has areas that occupy land immediately adjacent to the HHD. South Bay, which is actually about 2 miles (3.2 km) beyond the southern end of Reach One, is still relatively close to this area of concern.

Smaller communities that exist within 1 mile (1.6 km) of the HHD include Canal Point, Hooker Point, Lakeport, Buckhead Ridge, Taylor Creek, and Up-The Grove Beach. Although population estimates are not available for these communities, their relative nearness to the HHD is notable. Among these, Canal Point occurs along Reach One (see figure 1).

Tribal Indian Reservation

The Brighton Seminole Indian Reservation occupies a large area of land west of Lake Okeechobee in Glades County. The southern end of this reservation is near the HHD just north of Lakeport (Figure 1).

Transportation

Major transportation corridors around the perimeter of Lake Okeechobee include several highways and railroads.

County Road (CR) 78 parallels Lake Okeechobee along its western and northern shores from Moore Haven to Okeechobee. From Okeechobee, State Highway (SH) 98/441 follows the northern and eastern portion of the lake to Pahokee. County Road 715 then follows the HHD from Pahokee to Belle Glade, where SH 27 follows the southern lake area back to Moore Haven and CR 78. In many cases, these highways are within 1 mile (1.6 km) of the HHD, and are often within 50 ft (15 m).

TABLE 3
1996 POPULATION ESTIMATES FOR
COMMUNITIES SURROUNDING
LAKE OKEECHOBEE
(US CENSUS BUREAU, 1997)

Community	Population	County
Belle Glade ¹	16,656	Palm Beach
Clewiston	6,645	Hendry
Moore Haven	1,439	Glades
Okeechobee City	4,831	Okeechobee
Pahokee ¹	6,993	Palm Beach
South Bay	5,043	Palm Beach

¹ Located on Reach One

Railroad corridors in the Lake Okeechobee area include the Florida East Coast Railway and the South Central Florida Railroad. The East Coast Railway is located along the eastern part of the lake where it comes very near to the HHD in places along Reach One. The South Central travels along the southern end of the lake, where it comes within 1 mile (1.6 km) of the HHD in a just a few places.

Along Reach One, there are currently sets of transportation corridors that are in relative proximity to the HHD. Highway 98/441 parallels the HHD along the northern half of Reach One where it is within 328 ft (100 m) of the HHD for about 10 miles (16 km). Highway 715 parallels the southern half of Reach One where it is within 328 ft (100 m) of the HHD for about 6 miles (9.6 km). The nearest point either of these highways comes to the HHD is at the northern end of Reach One where SH 98/441 is about 150 ft (45 m) from the HHD for about 2400 ft (730 m).

The Florida East Coast Railroad parallels Reach One along the northern half as well, where it travels for about 8 miles (13.5 km) within 150 ft (45 m) of the HHD. In northern Pahokee, this railroad comes within 75 ft (23 m) of the toe of the HHD for about 2 miles (3.2 km). It comes within this distance again for about 1 mile (1.6 km) just north of culvert C-10A north of Pahokee (Figure 8).

Transmission Lines

A low voltage electric transmission line is situated on the landward slope of the HHD in the northern portion of Reach One. This transmission line is located on the lower third of the slope, above the toe ditch (Figure 7).

Communication

South of the West Palm Beach Canal, there is a Florida Highway Patrol communication tower. This

tower is 50 to 75 ft (15 to 23 m) beyond the toe ditch (Figures 7 and 10).

Limestone Quarries

A series of limestone quarries are located immediately south of culvert C-12 (near Paul Rardin Park) in the southern portion of Reach One. These quarries are found immediately at the toe of the HHD and are approximately 3000 ft (900 m) in length altogether (Figures 7 and 10).

3.16 AESTHETIC RESOURCES

There are five public access points to view Lake Okeechobee from the elevated vantage point of the levee crown in Reach One. The designated Florida National Scenic Trail (FNST) runs atop the HHD around the entire lake, totaling approximately 115 miles (FDOT, 1998). Panoramic lake and surrounding landscape view sheds vary depending on view access and obstruction in the area. The sounds of an occasional boater, airplane, ATV or farm implement can tend to break the otherwise peaceful setting.

The levee crown affords panoramic views of the flat agricultural fields to the east and rim canal and Torrey Island to the west. Foreground views are dotted with minor visual impediments such as guardrail, power lines, trees, and small structures. Moderate aesthetic values are experienced in this area from atop the levee crown dependent on the time of year and day.

The proposed Hooker Highway construction access point is amidst agricultural lands in a rural setting of moderate aesthetic value. The levee crown affords a panoramic view of agricultural fields to the east. The foreground view to the west is of the rim canal with a fringe of trees that form an immediate backdrop.

The proposed Paul Rardin Park construction access point, adjacent to Culvert 12, is an oasis of shade and possesses good aesthetic value. The park is covered

with sizeable fig trees that provide dense shade and a row of stately royal palms that line the entrance road from SR 715. Visitors who stop in the park to picnic or relax best experience the good park aesthetics.

The visual resources in the area of the proposed construction access adjacent to Culvert 12A are of moderate value from atop the levee facing east. The rim canal and panoramic views of Lake Okeechobee are apparent to the west of the levee. These views possess a high aesthetic value and can be spectacular during sunsets.

The Bacom Point (Culvert 10 off of SR 715) proposed construction access point is a pump station nestled in the levee. Few other structures are visible from the levee crown. The view to the east is of expansive agricultural fields that possess good aesthetic value. The City of Pahokee is visible on the horizon. The panoramic views of Lake Okeechobee possess very good aesthetic value, particularly during sunsets.

The City of Pahokee Marina and Campground (Pahokee State Park) is located on Lake Okeechobee west of Pahokee. The area is bordered by groups of trees spotted along the east and west side of the linear lakefront park. Views eastward from the levee crown are of adjacent residential back yards with agricultural fields beyond. These moderate aesthetic views are generally screened from the park user by the grassed levee. The park is clean and possesses good aesthetic quality. The lakefront park features and campsites overlook Lake Okeechobee and provide a panoramic view of good aesthetic value.

Canal Point Park is located on the shoreline of Lake Okeechobee adjacent to S-352 and the West Palm Beach Canal. The linear park provides panoramic views of the lake that possess good aesthetics. The landward side of the levee in this area is minimally developed with few homes and businesses. These views are foreground to near background and are of moderate aesthetic value. Agricultural fields comprise the background scenery of the Canal Point when viewed from the levee crown.

The visual resources in the area of the proposed construction access adjacent to Culvert 10A off of SR 15/700 are very rural. Agricultural fields are visible amidst a roadside border of trees that possess good aesthetic value when viewed from the levee crown. Panoramic views of Lake Okeechobee are visible to the west of Culvert 10A.

The visual resources in the area of the proposed construction access adjacent to Culvert 14 off of SR 15/700 are very rural. Agricultural fields are visible amidst a roadside border of trees that possess good aesthetic value when viewed from the levee crown. Panoramic views of Lake Okeechobee are visible to the west of Culvert 14.

Port Mayaca Lock and Spillway is located at the confluence of the St. Lucie Canal and Lake Okeechobee and is the northern limit of Reach One. The area is characterized by very low relief except for a few trees adjacent to the lockmaster's quarters, telephone poles with wires, and the lock structure. The port lands are grassed but possess moderate aesthetic value at best. The view of Lake Okeechobee is panoramic.

3.17 RECREATIONAL RESOURCES

A variety of recreation resources are enjoyed year-round on Lake Okeechobee. State Road 717 (near S-351) provides access to Torry Island adjacent to Belle Glade Municipal Golf Course. An existing bike path is located on the north lane of SR 717 which terminates at the base of the dike (FDOT, 1998). The Belle Glade Recreation Area on Torry Island includes a multi-laned boat ramp, marina and campground. The J-Mark Fish Camp and Slim's Fish Camp are also located on Torry Island (Greater Lake Okeechobee Tourist Alliance, 1997). Kreamer Island is just north of Torry Island and is renowned for its fishing, bird watching and hunting. It is accessible by boat only, except during extremely low lake levels. The rustic recreation facilities in this project area are utilized throughout the year and are important to residents, budget minded tourists, and the local economy.

There are no developed recreation facilities at the proposed construction access point off of Hooker Highway off SR 15. However, the location is a primary FNST trailhead and the dikes' elevation provides an excellent vantage point for bird watching and sightseeing (FDOT, 1998). Plans for an interpretive kiosk to inform visitors of the former sugar barge loading area are underway (GLOTA, 1997).

Paul Rardin Park is approximately 3.5 miles north of SR 717, adjacent to Culvert 12. The park is a main trailhead to the dike and supports the second highest visitation for sightseeing in Reach One (FDOT, 1998). The park maintains paved vehicular access, parking, picnic, and restroom facilities. A paved boat ramp for access to Lake Okeechobee's rim canal is adjacent to the park. It is owned and maintained by

Palm Beach County. The park is a refuge from the hot Florida summers and provides an oasis for locals and tourists alike. Park improvements proposed include a small fishing pier with limited cover and an interpretive kiosk (GLOTA, 1997). A borrow pit/quarry is to the immediate south and intense agricultural practices occur in the fields that border the park to the east and north (USGS, 7.5MI, 1990).

There are no developed recreation facilities at the proposed construction access point adjacent to Culvert 12A. Localized bank fishing occurs at this site. The pump station is located at the southern tip of the local airport and is not developed for structured recreation.

Bacom Point (Culvert 10 off of SR 715) proposed construction access point is a pump station that has no developed recreation facilities but does provide local bank fishing access. The City of Pahokee Marina and Campground (Pahokee State Park) is located on Lake Okeechobee approximately five miles north of Paul Rardin Park. The park provides lakeside camping, RV hookup, a lighted fishing pier, a marina, boat ramps, bait shop, a scenic overlook, and an educational facility. Restrooms, showers, laundry, and telephones are provided. Vendors provide concession amenities. The linear park has the highest use rate of any park in FDOT-District 4 (FDOT, 1998).

Canal Point Park is located on Lake Okeechobee approximately five miles north of Pahokee Marina and Campground (Pahokee State Park), adjacent to S-352 and the West Palm Beach Canal and serves as a primary FNST access point (FDOT, 1998). The linear park provides expansive views of the lake, offers tree-shaded picnic facilities, shoreline fishing, and a small-hardened boat ramp. Retail services are close by and support the recreation resources at Canal Point. Historical points of interest are in close proximity to the park. The primary point of activity is the north side of the dike where L-10 remains. The remnants of the walls and doors of the historical West Palm Beach Canal Lock are a testament to past activity. Local residents fish from the lock walls, banks, and bridge.

The proposed construction access adjacent to Culvert 10A off of SR 15/700 has no formal recreation facilities but does provide local bank fishing access. The proposed construction access adjacent to Culvert 14 off of SR 15/700 has no formal recreation facilities but provides unstructured bank fishing access for locals. Port Mayaca Lock and Spillway is located at the confluence of the St. Lucie Canal and

Lake Okeechobee approximately seven and a half miles north of Canal Point Park where SR 76 intersects with Highway 441. The proposed park area is approximately 250 acres and includes lands on the lake, canal, rim canal, and basin. Many recreation plans have been discussed and coordinated for the Port Mayaca Lock and Spillway site. The lands possess potential for park development of regional significance given the location and proximity to waterway and highway infrastructure. The area is evenly grassed and well maintained with few trees on the property. Views of the lake are some of the best in the region. The port's lands provide bank fishing in the lake, rim canal, St. Lucie Canal, and lock basin. The property provides boat access to the basin, canals, and lake. The property is void of any structured recreation facilities, however the designated FNST crosses the property (USDA, 1986). When the fish are migrating (early spring through early summer) the basin receives intense fishing pressure.

The U.S. Department of Agriculture, Forest Service, produced the Florida National Scenic Trail Comprehensive Plan, 1986, which proposed a multi-use trail for the top of HHD by authority of the 1968 National Trails System Act (P.L. 90-543, 82 Stat. 9119). A composite analysis of land use and ownership determined a conceptual trail layout from the panhandle across Federal and state owned recreation lands and waterways. Lake Okeechobee is completely surrounded by the USDA's proposal (USDA, 1986). Since that time recreation studies have included dike trail access as an important consideration and vital aspect for further developing potential recreation in the communities that border the lake and dike. Each year the three day, 110-mile Big "O" Bike Tour, fully supports fat tire bike riders, begins in Okeechobee and heads south around the lake (Chamber of Commerce, 1998).

The economic effects of recreation activities that occur in the Lake Okeechobee region, because of the lake, have been estimated to be approximately \$78M in 1996 figures (GLOTA, 1998).

3.18 CULTURAL RESOURCES

The earliest widely accepted date of occupation of Florida dates from around 12,000 years ago. This earliest cultural period, termed the Paleo-Indian period, lasted until about 7500 B.C. Few Paleo-Indian archeological sites are recorded in Florida, and none are identified by the Florida Master Site Files (FMSF) near Reach One of the HHD. The Archaic period, (ca. 7500 B.C. - ca. 500 B.C.), is thought to be a reflection of man's adaptation to the changing

environment at the start of the Holocene, when our basically modern climate and biota were established. Archaic Indians exploited a wider range of resources than Paleo-Indians, probably utilized a more restricted territory, and may have led a more sedentary existence. Seasonally available food resources, including deer and small game, hardwood nuts, freshwater snails, and marine shellfish were used during the Archaic (Milanich 1994). The Archaic is further subdivided into the Early Archaic (7500 B.C. to 5000 B.C.), Middle Archaic (5000 B.C. to 3000 B.C.) and Late Archaic (3000 B.C. to 500 B.C.). Few Early or Middle Archaic period archeological sites are recorded in south Florida, and known sites are clustered along the Atlantic and Gulf coasts and inland waterways (Milanich 1994). Foraging and hunting are the main subsistence activities throughout the archaic period, with Late Archaic people exploiting a larger territory and wider range of aquatic and terrestrial food resources (Almy 1996). Archaic sites become more numerous during the Late Archaic period, when essentially modern climatic conditions had been established. Crude fiber-tempered pottery first appears in the Late Archaic. No Archaic period sites are located near Reach One, as recorded in the FMSF. Regional cultural diversity becomes apparent in the archeological record by 500 B.C. The clearest indication is that distinctive styles of pottery were made in different parts of the state (Piper Archaeology/Janus Research 1992). In the Okeechobee Basin, the Belle Glades culture sequence (ca. 500 B.C. - A.D. 1500) is subdivided into four periods. Ceramic technology progresses from fiber tempered to fiber and sand tempered to sand tempered ceramics, with St. Johns ceramic types also being used during the Belle Glades culture sequence. Black earth middens, low sand mounds and circular and linear earthworks are Belle Glade site types located near the HHD, as recorded in the FMSF.

During the early historic period, beginning with the first Spanish colonial period (1513 - 1763), the Calusa inhabited southern Florida. Their population was decimated by European-introduced diseases, warfare, enslavement, and migration out of Florida (Archaeological Consultants Inc 1991). The Miccosukee and the Seminole migrated into Florida in the 18th and 19th centuries from Georgia and Alabama. Throughout the mid 1800's the U.S. relentlessly pursued a policy of Indian removal in Florida, and the Seminole, resisting removal, eventually establishing themselves in the Everglades, Big Cypress Swamp, and the Ten Thousand Islands. Several important battles of the Seminole Wars occurred around Lake Okeechobee including the

largest and bloodiest battle of the Second Seminole War, the Battle of Okeechobee on Christmas Day in 1837 (Carr et. al. 1995). The Okeechobee Battlefield site is located at the north end of Lake Okeechobee and is a National Historic Landmark site. Other Seminole battle and habitation sites, predominantly on tree islands, are located near the HHD.

American settlement around Lake Okeechobee began in earnest in the late 19th century when efforts to drain and reclaim the Everglades began. Agriculture began in the Everglades, south of Lake Okeechobee after drainage projects of the 1906-1927 era (Milano 1995). During this period, the first settlements, Okeelanta and Glade Crest were established just south of the lake. By 1921, there were 16 settlements on or near Lake Okeechobee, with a total estimated population of 2,000. Settlement and agricultural activities escalated during the subsequent decades. The West Palm Beach Canal opened in 1917 and the town now known as Canal Point was established (Archaeological Consultants, Inc. 1991). In 1918 a school was built in Pahokee. By 1920 mercantile and commercial buildings were springing up along the lake. As early as 1917 sugar cane was being produced, and quickly became a flourishing industry in the region. The mid 1920's saw the south Florida real estate boom, which was crippled by the great hurricane of 1926. The 1928 hurricane devastated the recovery from the earlier storm with tremendous property damage and loss of lives (Archaeological Consultants, Inc. 1991). South Florida benefited from the civic and administrative works of Franklin D. Roosevelt's New Deal programs in the 1930's, including the Canal Point School, a structure determined eligible for inclusion on the National Register of Historic Places. After the hurricanes, work was begun locally to build a series of dikes around Lake Okeechobee. In 1935 the Corps assumed responsibility for the on-going construction. The HHD was completed in 1937 and named after President Herbert Hoover. The SHPO has listed the HHD as eligible for inclusion on the National Register of Historic Places for its historical significance.

3.19 SOCIOECONOMICS

The major socioeconomic resources in the Lake Okeechobee region are related to agriculture, recreation and tourism, commercial navigation, and commercial fishing.

Agriculture in this region is dependent upon Lake Okeechobee as a source of irrigation water. The regulated lake depths make it possible for farmlands to receive irrigation water year round regardless of

rainfall. In the Lake Okeechobee service area, there are an estimated 742,668 acres of irrigated agricultural lands. These agricultural lands and associated activities employ hundreds of people in the area and bring millions of dollars in revenue annually.

Agriculture in the vicinity of Reach One is dependent on releases from Lake Okeechobee for crop irrigation. During prolonged droughts, significant volumes of water from the lake are required to supplement local water supplies and to prevent saltwater intrusion into coastal aquifers and wellfields. Most of the land in the vicinity of Reach One is under cultivation. Agriculture in Reach One is dominated by sugarcane, accounting for 90% of land under cultivation. The remaining 10% of cultivated land primarily includes rice, row crops, and sod (David Miller & Associates, 1998).

Recreation and tourism activities in the area are enhanced by the regulated water levels of Lake Okeechobee. As a result, the lake is the largest recreational resource in the region. It has been an historic tourist destination, and its associated waterways and shoreline provide a wide variety of water-based recreation activities for local residents and out-of-state visitors, including: fishing, boating, picnicking, sightseeing, camping, swimming, birding, hunting, air boating and hiking. The recent trend toward eco-tourism has been encouraged by the planned extension of the Florida National Scenic Trail and creation of the Lake Okeechobee Scenic Trail. In 1996, the annual value of the recreational resources of the lake was estimated at \$78,151,409 (David Miller & Associates, 1998).

Heavy waterfowl utilization of Lake Okeechobee attracts tourists and recreational enthusiasts. Common waterfowl species include ring-necked duck (*Aythya collaris*), American widgeon (*Anas americana*), northern pintail (*A. acuta*), green-winged teal (*A. crecca*), Florida duck (*A. fulvigula*), and lesser scaup (*Aythya affinis*).

Lake Okeechobee supports a variety and abundance of sport fish. Consequently, sport fishing is a major recreational activity on the lake. Lake Okeechobee is currently recognized as supporting one of the best recreational fisheries in the nation. Additionally, it supports an active commercial fishing industry. This includes several different types of commercial fishing operations and landside support activities, such as marinas and wholesale and retail distribution facilities. The annual value of the wholesale

commercial fishing is \$2,326,932 and employs 210 people (David Miller & Associates, 1998).

There are also commercial fisheries on Lake Okeechobee that harvest the American alligator and the Florida soft shell turtle. Alligators are harvested from the lake population to supplement the stock in alligator farming operations. Soft shell turtles are harvested by commercial fishermen, with some individual yields in excess of 30,000 pounds (13,640 kilograms) annually. The majority of the harvest is prepared for shipment to Japan, or sold locally, primarily to the Miccosukee Tribe (Moler & Berish, 1995).

The increased depth of Lake Okeechobee makes commercial navigation on the lake possible. Commercial navigation of Lake Okeechobee and associated waterways was used to transport 430,000 tons of freight in 1995. Petroleum products, including distillate fuel oil, residual fuel oil, and liquid natural gas, comprise the majority of tonnage shipped. Other commercial navigation includes fleets of day/dinner cruise vessels that operate during the tourist season from Pahokee and from Ft. Myers and other commercial guided tours.

4.0 ENVIRONMENTAL CONSEQUENCES

4.01 INTRODUCTION

This section discusses potential impacts to the existing environment that may result from implementation of each proposed alternative. A summary of environmental consequences is displayed in Table 4 as presented by the Corps.

4.02 CLIMATE

No impact to the climate is expected to occur as a result of implementing any of the alternative actions, including the no action alternative.

4.03 TOPOGRAPHY, GEOLOGY AND SOILS

Topography

No Action Alternative

Selection of the No Action Alternative would cause no significant changes to the topography of Reach One or Lake Okeechobee region. Although the potential for failure of the HHD system persists under this alternative, major topographic alterations would not occur as a result of a project failure.

Alternatives No. 1, 2, 3 & 4

No significant impact to the topography of Reach One or Lake Okeechobee region is expected to occur as a result of implementing any of the alternative actions. Minor changes would occur in the immediate areas where excavation and fill activities take place, but these would cause only minimal changes to the overall topography of these areas.

Geology

No impact to the geology of Reach One or Lake Okeechobee region is expected to occur as a result of implementing any of the alternative actions including the No Action alternative.

Soils

No Action Alternative

Although the No Action Alternative would not cause physical changes in the study area, the current instability problems would persist. In the event of dike failure, surging waters could displace mass volumes of soils in the areas nearest the failure. Given the importance of agriculture in the Lake Okeechobee area and its dependence on soil, this would be a significant loss.

Alternative No. 1

Minimal soil disturbance would occur as a result of implementing Alternative No. 1. Plans include excavation of 3 ft to 4 ft (0.9 m to 1.2 m) of peat along the landward slope of the HHD prior to construction of a stability berm. Any other soil disturbances such as those associated with movement of heavy equipment would be minimal.

Alternative No. 2

Minimal soil disturbance would occur as a result of implementing Alternative No. 2. Excavation of the channel for the cutoff wall would result in soil displacement near the crest of the HHD. Plans also include excavation of 3 to 4 ft (0.9 m to 1.2 m) of peat along the landward slope of the dike prior to construction of a stability berm. Any other soil disturbances such as those associated with movement of heavy equipment would be minimal.

Alternative No. 3

Soil impacts resulting from implementing Alternative No. 3 would be minimal. Excavation of an area 25 ft (7.6 m) wide, and 4 ft (1.2 m) deep along the length of Reach One would be required prior to construction of the seepage berm, and would involve only the area in the immediate vicinity of the embankment toe. Any other soil disturbances such as those associated with movement of heavy equipment would be minimal.

Alternative No. 4

Minimal soil impacts would result from implementing Alternative No. 4. Excavation of the channel for the cutoff wall would result in soil displacement near the crest of the HHD. Excavation of the relief trench would be limited to the area adjacent to the toe ditch. Any other soil disturbances such as those associated with movement of heavy equipment would be minimal.

4.04 HYDROLOGY

Evaporation

No Action Alternative

The No Action Alternative would have a moderate affect on evaporation. During a flood event, the lake water would cover a larger area. An increase in surface area would result in a corresponding increase in evaporation, especially if it were to occur during the summer months. Implementation of this

alternative could have similar consequences in Reach One as in the remaining Reaches.

Alternative No. 1

Increasing the water level in the drainage ditches would have minimal effect on evaporation as the water surface area would not increase significantly.

Alternative No. 2, 3 & 4

Implementation of these alternatives would have minimal effect on evaporation as the water surface area would not increase.

Outfall

No Action Alternative

In the event of a major failure of the HHD, consequential flooding could have extensive effects on the hydrologic regime of Reach One and the Lake Okeechobee region. The No Action Alternative allows current stability problems of the HHD to persist, which could lead to a major breach of the HHD during a substantial high water event.

Alternative No. 1

Implementation of Alternative No. 1 is anticipated to result in moderate impacts to the hydrology along Reach One. Raising the water levels in the ditches would increase the potential for localized flooding.

Alternative No. 2

Implementation of Alternative No. 2 is anticipated to result in moderate impacts along Reach One. The installation of an impervious cutoff wall and to impede groundwater flow, the possible lowering of the water table due to the cutoff wall may reduce the amount of water available for discharge.

Alternative No. 3

Implementation of Alternative No. 3 is anticipated to result in minimal impacts along Reach One. Installation of a seepage berm with relief trench is not expected to significantly affect discharge during high-water events.

Alternative No. 4

Implementation of Alternative No. 4 is anticipated to result in minimal impacts along Reach One. The installation of an pervious hanging cutoff wall which allows groundwater to flow under the HHD and only limits hydrology in the immediate HHD region is not anticipated to lower the water table or reduce the amount of water available for discharge.

Recharge

No Action Alternative

The No Action Alternative would have minimal effect on recharge along Reach One. Implementation of this alternative should not result in any significant impacts to the remaining reaches of the HHD.

Alternative No. 1

Improvement to the existing ditches and controlled water levels are not anticipated to affect recharge.

Alternative No. 2

Implementation of Alternative No. 2 is anticipated to result in moderate impacts along Reach One. The installation of a cutoff wall impeding groundwater flow and lowering the water table would affect the principal source of recharge in this area and decrease the effectiveness of subsurface percolation from the canals into the permeable sediments.

Alternative No. 3

Implementation of Alternative No. 3 is anticipated to result in minimal impacts to recharge along Reach One. The installation of an inverted filter and a relief trench would control artesian pressures, allowing for more effective percolation through the sediments and more effective recharge to surficial aquifer systems.

Alternative No. 4

Implementation of Alternative No. 4 is anticipated to result in minimal impacts along Reach One. The cut-off wall and relief trench would allow percolation through the sediments and effective recharge to surficial aquifer systems.

4.05 WATER SUPPLY

Public Water Supply

No Action Alternative

The No Action Alternative would have a minimal effect on existing current water supply issues. In the event of a levee breach in the HHD, even a major one, water levels are expected to recede slowly so that implementing water conservation measures should not be needed.

Alternative Nos. 1, 2, 3 and 4

Implementation of Alternative Nos. 1, 2, 3 or 4 are anticipated to have minimal impacts on current public water supply issues along Reach One. The proximity of the Pahokee water facility to the HHD may present some permitting issues if a water quality issue is perceived by concerned agencies. The Corps is not aware of any water quality concerns at this time that

would adversely affect this resource. The facility is far enough away from the proposed construction area to avoid direct impacts. Alternative 4 should not have any substantial effect on the water supply within the Lake Okeechobee area.

Agricultural Water Supply

No Action Alternative

In the unlikely event of a failure of the HHD, consequential flooding could have significant effects on agricultural lands in the area of the failure. The No Action Alternative allows current stability problems of the HHD to persist, which could lead to a major breach of the HHD during a substantial high water event. In addition, the disruption of agricultural water supply at a critical time during the growing season could have detrimental effects on the local economy. Additionally, loss of crops in the vicinity of the breach could be substantial if the breach were to occur in a heavily farmed area.

Selection of the No Action Alternative could result in extensive consequences to agricultural lands around Lake Okeechobee, and along Reach One.

Alternative No. 1

Implementation of Alternative No. 1 is anticipated to result in only moderate impacts to the agricultural water supply along Reach One. Water levels in the ditches are controlled by local drainage districts and farmers. Under this alternative, these entities would no longer have this control. Culverts with automatic/manual gates and pumps would be installed to control the water level in ditches along Reach One. Water levels could thus be raised as needed to decrease differential head, and increase the stability of the HHD. The overall influence of altered water levels in these ditches is significant if it is perceived as loss of irrigation water by the local agriculturists.

Implementation of this alternative should not result in any significant impacts to agricultural water supply in the remaining reaches of the HHD.

Alternative No. 2

Implementation of Alternative No. 2 is anticipated to result in moderate impacts to agricultural water supply along Reach One. Installation of a cutoff wall along the length of this Reach could result in reduced tail-waters. The extent of this reduction, if any, is unknown, but any reduction in irrigation waters could adversely affect irrigated crops in this area.

Alternative No. 3

Implementation of Alternative No. 3 is anticipated to result in minimal impacts to the agricultural water supply along Reach One. The perforated culvert system included in the seepage berm design would collect and convey water into existing drainage canals, just as the existing toe ditches have done.

Alternative No. 4

Implementation of Alternative No. 4 is anticipated to result in minimal impacts to agricultural water supply along Reach One. SEEPW modeling of groundwater flow indicated negligible influence on water table and flow beyond the HHD's toe ditch. In addition, the levels in the existing irrigation conveyance ditches would not change as a result of the relief trench.

4.06 WATER QUALITY

No Action Alternative

The No Action Alternative would have moderate effects on existing water quality due to increased sediments in the surface waters nearest a breach. Implementation of this alternative should not result in any significant impacts outside of the immediate area of the breach. It is fair to envision though, in the event of a high velocity breach in the general area between the St. Lucie and L-8 Canals, in combination with high lake levels, that downstream discharge towards the St. Lucie Estuary may cause significant adverse impacts to the estuarine ecosystem. Massive discharges as a result of a breach could also transport the mud sediments of Lake Okeechobee to the near shore region close to the breach. This would result in localized elevated total suspended solids and elevated phosphorus concentrations.

Alternative Nos. 1, 2, 3 & 4

Implementation of Alternative Nos. 1, 2, 3 or 4 is expected to have minimal to moderate temporary impacts on the water quality along Reach One. Construction activities may result in increased sediment load in nearby surface waters. Silt screens and Best Management Practices (BMPs) would be implemented during and after construction to reduce this potential effect.

4.07 WATER MANAGEMENT

No Action Alternative

The No Action Alternative would have moderate effects on the existing water management of Reach One. In the vicinity of the breach and resulting flooded area, water levels resulting from a major dike failure would necessitate implementation of significantly different management activities by those

entities responsible for, and relying upon, the lake's water resources.

Alternative No. 1

Implementation of Alternative No. 1 is anticipated to have moderate impacts on the water management along Reach One. Increased water levels in the drainage ditches would continue to be managed according to a regulation schedule that was developed by the SFWMD and the Corps. However, the loss of control by the local management districts could create political issues.

Alternative No. 2

Implementation of Alternative No. 2 is anticipated to have minimal impacts on water management along Reach One.

Alternative No. 3

Implementation of Alternative No. 3 is anticipated to have minimal impacts to water management along Reach One. The culvert system for collecting seepage flows and surface runoff would continue to be managed according to a regulation schedule that was developed by the SFWMD and the Corps.

Alternative No. 4

Implementation of Alternative No. 4 is anticipated to have minimal impacts on water management along Reach One. The toe ditch and relief trench used for collecting seepage flows and surface runoff would continue to be managed according to a regulation schedule that was developed by the SFWMD and the Corps.

4.08 VEGETATION AND COVER TYPES

No Action Alternative

The No Action Alternative and the continued potential for dike failure could result in extensive impacts to the vegetation landward of the HHD.

Loss of vegetation landward of the HHD would occur in the immediate area of the failure. This loss would result from surging water that would impact sugarcane plantations, ornamental orchards, field crops, and natural vegetation. Further, an interruption in the current hydrology, such as less irrigation over the long-term, could severely inhibit the ability to grow commercial crops. Additionally, de-vegetation of these areas could provide an area for invasive plant species to expand into.

Loss of vegetation waterward of the HHD in the event of a dike failure would be minimal. Some loss of aquatic vegetation would be expected in the

immediate vicinity of the breach; however, the overall reduction in lake levels would be relatively small and no impacts to vegetation would be experienced in areas away from the breach site.

Alternative Nos. 1, 2 & 3

Implementation of Alternative Nos. 1, 2, & 3 would cause only minimal impacts to existing vegetation, would be temporary in nature, and limited to the immediate areas of construction. Along the landward side where major construction occurs, existing vegetation would be disturbed. This would impact mixed grasses along the slope of the HHD, and vegetation in the toe ditches. Much of the ditch vegetation is considered nuisance vegetation, such as water hyacinth, water lettuce, and hydrilla.

Alternative No. 4

Implementation of Alternative No. 4 may have minimal effects to vegetation as construction would occur only within the HHD footprint and avoids dredging or altering the existing toe ditch. Impacts would be limited to the mixed grasses on the slope and toe of the dike.

4.09 WETLANDS

No Action Alternative

Selection of the No Action Alternative would lead to minimal wetland impacts if there should be a failure of the HHD system. These impacts would result from increased water levels due to flooding landward of the HHD.

Landward, wetland impacts in the area of Reach One would be minimal because of the relatively few quality wetlands remaining in this area. Wetland systems in the remaining reaches would not be affected due to the relatively small change in lake level that would result from a breach of the HHD.

Waterward, wetland impacts due to lower lake levels would be minimal. Conditions under which a breach would be likely, and corresponding breach-related reduction in lake levels, would not result in levels that approach the minimum water level criteria (Section 4.07). In the event of a prolonged scenario in which repairs of a large breach take more than a month to repair, water levels would still not fall below the front toe of the levee.

Alternative No. 1

Wetland impacts resulting from implementation of Alternative No. 1 would be minimal and limited to Reach One. This alternative involves raising water levels landward of the HHD during high lake water

events. This practice would reduce differential head, and increase dike stability during these times. The landward wetlands involved could be altered, though not necessarily resulting in a negative outcome. Wetland areas could potentially enlarge as a result of this increased water level, providing additional wildlife habitat.

Alternative No. 2

Wetland impacts resulting from implementation of Alternative No. 2 would be moderate and limited to Reach One. This alternative involves construction of a cutoff wall which could potentially alter the amount of water that wetlands landward of the HHD receive.

Alternative No. 3

Wetland impacts resulting from implementation of Alternative No. 3 would be moderate. This alternative involves converting existing toe ditches to a controlled system of covered culverts as part of a seepage berm. This activity would eliminate the foraging potential along these ditches. Although these areas provide less than optimal habitat, a variety of wading birds, small fishes and invertebrates utilize the ditches. Impacts would require mitigative measures

Alternative No. 4

Wetland impacts resulting from implementation of Alternative No. 4 would be minimal. The previous cutoff wall would allow groundwater and the percolation of water into wetlands landward of the HHD. The toe ditch and relief trench would collect surface and seepage water and not impact wetland resources. Wetlands impacted by construction activities would be minimized by avoiding alteration of the toe ditch and constructing a relief trench adjacent to it. Impacts to wetlands and foraging habitat would therefore be minimal.

4.10 FISH AND WILDLIFE

No Action Alternative

The No Action Alternative would cause no direct impact to fish and wildlife in the Lake Okeechobee area. However, the current instability problems would persist, and probability of unsatisfactory performance of the HHD could increase. In the event of HHD failure, minimal loss of wildlife habitat would occur waterward of the HHD. This is due to the relatively small reduction in lake level that would result from a failure. Modeling results demonstrate less than 0.75 ft (0.23 m) drop in lake levels within 45 days at 18 ft (5.5 m) NGVD, in the event of a breach in Reach One (USACE, 1998).

The implications to fish and wildlife landward of the HHD that may result from dike failure would be limited to the areas of the breach and surrounding habitats. In the area of Reach One, fish and wildlife habitat is marginal. However, those animals most significantly affected by extensive flooding include those with limited mobility. Amphibians, reptiles, and small mammals would be impacted to a moderate degree.

Alternate No. 1

Fish and wildlife impacts resulting from implementation of Alternative No. 1 would be minimal and limited to Reach One. Since this alternative involves raising water levels landward of the HHD periodically, wildlife areas (primarily ditches) would be impacted to some extent.

Alternate No. 2

Fish and wildlife impacts resulting from implementation of Alternative No. 2 would be moderate and limited to Reach One. This alternative involves construction of a cutoff wall that could potentially alter the amount of water wetlands landward of the HHD receive. These are virtually the only remaining wetland habitats landward of Reach One, and although these are low quality habitats, negative impacts would be moderate.

Alternate No. 3

Fish and wildlife impacts resulting from implementation of Alternative No. 3 would be minimal to moderate and limited to Reach One. This alternative involves converting existing toe ditches to a controlled system of covered culverts as part of a seepage berm. This activity would eliminate the foraging potential along these ditches. Mitigation to replace habitat would be required.

Alternative No. 4

Fish and wildlife impacts resulting from implementation of Alternative No. 4 would be minimal. The previous cutoff wall would allow groundwater and the percolation of water into wetlands landward of the HHD. The toe ditch and relief trench would collect surface and seepage water and not impact wetland resources. Foraging habitat to wading birds, reptiles, and amphibians, would be maintained within the toe ditch. Impacts from construction activities could temporarily displace wildlife utilizing the HHD slope. Precautions for threatened and endangered species are discussed in the following section and Section 5.0.

4.11 THREATENED AND ENDANGERED SPECIES

American alligator

Alligator mississippiensis

No Action Alternative

The American alligator should incur only minimal short-term impacts in the event of a dike failure both waterward and landward of the HHD. Flexibility in habitat usage and mobility should allow this animal to survive in the Lake Okeechobee region even in the event of major water level drop. If a dike failure should occur during nesting season, the impacts waterward should be minimal since water levels are not expected to decrease significantly during such an event. However, the potential for impacting nests landward of the dike exists in the immediate vicinity of a breach.

Alternative Nos. 1, 2 & 3

Impacts to the American alligator resulting from implementing Alternative Nos. 1, 2, or 3 would be minimal to moderate. Any impacts would be limited to the immediate area of construction.

In Alternative No. 4, wetland impacts have been reduced by maintaining construction to the slope of the dike. Therefore, minimal effects to alligators from construction would occur within the HHD footprint.

Eastern Indigo Snake

Drymarchon corais couperi

No Action Alternative

The indigo snake would likely only be affected minimally in the event of a dike failure. Low utilization of areas waterward of the HHD, would limit potential impacts. The levee itself provides useable habitat for the indigo snake, but a dike failure would only directly affect animals in the immediate vicinity. Landward, this animal is rarely observed due to sub-optimal habitat. Any impacts would be minimal, and only in the immediate area of the dike failure.

Alternative Nos. 1, 2 3 & 4

Impacts to the indigo snake resulting from implementing Alternative Nos. 1, 2, 3 or 4 would be minimal to moderate, and limited to the immediate area of construction. Considering the quality of existing habitat for the eastern indigo snake along the lower third of the HHD, construction impacts may occur, but impacts to snakes will be mitigated by

proper implementation of an environmental protection plan (see Section 5.0).

Bald Eagle

Haliaeetus leucocephalus

No Action Alternative

The slightly lower water levels resulting from a dike failure should impact the bald eagle to a minimal extent. The expected decrease in water level is too minor to significantly affect its foraging activities around the lake.

Alternative Nos. 1, 2, 3 & 4

Impacts to the bald eagle resulting from implementing Alternative Nos. 1, 2, 3 or 4 are expected to be minimal. However, the existence of an active bald eagle nest could alter construction plans. An active nest within 1500 ft (457 m) of the HHD would restrict construction activities during nesting season. Surveys for active bald eagle nests would be conducted prior to construction. Bald eagle nesting areas would be subject to USFWS Nesting Protection Measures, where applicable.

Implementation of a selected alternative should not have any significant impacts to the bald eagle along the remaining reaches of the HHD.

Wood Stork

Mycteria americana

No Action Alternative

Impacts to the wood stork in the event of a dike failure would be minimal. Slightly lower lake levels could result in slightly less foraging habitat around the lake. Any nesting colonies could be deserted if de-watered at a critical nesting time during the year; however, reduction in lake level due to breaching would be minimal.

Alternative Nos. 1, 2 & 3

Impacts to the wood stork resulting from implementing Alternative Nos. 1, 2, or 3 would be minimal to moderate. The wood stork could potentially utilize the toe ditch and adjacent wetlands for foraging activities.

Implementation of Alternative No. 4 would have minimal impacts to wood storks and stork habitat. Construction activities adjacent to the toe ditch may temporarily displace wood storks from foraging in the area; However, the toe ditch would not be filled or converted to a closed system. Storks would be expected to return post-construction.

Everglade Snail Kite

Rosthrhamus sociabilis plumbeus

No Action Alternative

Impacts to the snail kite's significant habitat around Lake Okeechobee would be minimal if there should be a major dike failure. The water level must be sufficiently stable to prevent loss of the apple snail through drying out of the surface. Water loss in this area, in the event of a dike failure would not be great enough to seriously affect successful foraging of the highly mobile snail kite.

Alternative Nos. 1, 2, 3 & 4

Impacts to the snail kite resulting from implementing any of the alternatives would be minimal, and restricted to the immediate area of construction. Construction activities would be limited to the levee itself and the landward side of the levee where this animal doesn't forage extensively. Aside from temporal disturbance caused by the operation of heavy equipment, no impact is expected waterward either. Due to the relatively narrow littoral zone, this area provides minimal snail kite foraging habitat, so impacts are unlikely.

West Indian Manatee

Trichechus manatus

No Action Alternative

Minimal impacts to the manatee are expected to occur in the event of a dike failure. Expected water level reductions would not be great enough to affect the animal's food supplies or exposure to boat-related injury or death.

Alternative Nos. 1, 2, 3 & 4

Impacts to manatee resulting from implementing any of the alternatives would be minimal to none. Construction activities would be limited to the levee itself and the landward side where this animal does not occur.

Okeechobee Gourd

Curbita okeechobeensis o.

No Action Alternative

Okeechobee gourd plants that are currently known to exist in the Lake Okeechobee region are limited to the shores of the lake inside of the HHD. Slightly lower lake levels resulting from a major dike failure would have minimal impact to the existing Okeechobee gourd population in this area. However, given its limited range and habitat requirements, any alteration in the hydrology where this plant currently exists could significantly damage the population.

Impacts to these gourds would most likely occur with sustained high water events, rather than low.

Alternatives Nos. 1, 2, 3 & 4

Implementation of any of the alternatives would not likely cause impacts to the Okeechobee gourd. The occurrence of this plant along the landward extent of Reach One has not been recorded in recent years.

4.12 NOISE

No Action Alternative

The No Action Alternative would not increase ambient noise levels in the vicinity of the HHD. Therefore no impacts are expected to result due to selection of this alternative.

Alternatives Nos. 1, 2, 3 & 4

The implementation of any of the alternatives could potentially result in some noise impacts, but would be limited to the sites directly associated with construction activities. Occasional heavy machinery activity in these areas would produce noise levels above 70 dB in localized areas, but would occur sporadically and should not lead to reduced attenuation of animal species or humans living near the area. Staging areas that would be established at suitable locations within the Corps right-of-way may experience potential noise impacts, as well as access routes to the crown road. Such routes include the following:

- a. County Road 717 near S-351
- b. Hooker Highway off SR 15
- c. Paul Rardin Park off SR 715
- d. Culvert 12A off SR 715
- e. Culvert 10 off SR 715
- f. Pahokee State Park off SR 715
- g. S-352 off SR 715
- h. Culvert 10A off SR 15/700
- i. Culvert 14 off SR 15/700
- j. Port Mayaca (S-308) off SR 15/700.

4.13 AIR QUALITY

No Action Alternative

Selection of the No-Action Alternative would not impact air quality in the vicinity of the HHD.

Alternatives Nos. 1, 2, 3 & 4

Emissions associated with each of the alternatives would be largely generated from heavy machinery operating for short periods in the area of Reach One. Construction activities would cause minor short-term air quality impacts in the form of fugitive dust or

airborne particulate matter from earthwork and unpaved roads accessed for the project.

The area is rural and the existing air quality is good to moderate, additional short-term loadings of internal-combustion engine gases would not substantially impact the quality of the air in the vicinity of the HHD.

Every Federally funded project must be consistent with state plans for implementing the provisions of the Clean Air Act Amendments (State Implementation Plans). This project is in conformance with the State Implementation Plan because it would not cause violations of the National Ambient Air Quality Standards.

4.14 HAZARDOUS, TOXIC AND RADIOACTIVE WASTES

The project conditions assume that any HTRW found during any phase of the project would be remediated in accordance with local, state and Federal laws. Therefore, it can be assumed that conditions at future construction sites would be contamination free or of low levels, which would include de minimis conditions that generally do not present a material risk of harm to public health or the environment.

Within the agricultural areas there are numerous temporary pump sites and fuel storage areas. These makeshift portable tanks are not reported, and therefore are not presented in the HTRW database. In addition, pesticide/chemical-mixing areas may also exist. Agricultural fields, outbuildings, equipment fueling and agricultural processing facilities are expected to be outside of the immediate area of construction and should not pose an HTRW concern. Project implementation requires that any HTRW problems revealed during the real estate acquisition or actual project construction require full remediation.

Alternatives Nos. 1, 2, 3 & 4

Implementation of any of the alternatives is not anticipated to affect or contribute to HTRW in the region.

4.15 LAND USE

Agriculture

No Action Alternative

The No Action Alternative could potentially have the greatest impact on agriculture in the Lake Okeechobee area. In the event of a major structural failure of the HHD, consequential flooding could

have detrimental effects on crops in the area of the failure. In the vicinity of Reach One, sugarcane, ornamental nurseries, and vegetable production are the major production crops. Flood waters from a breach of Reach One could result in immediate and long-term damage to crops in this area. The extent of agricultural damage in total acreage would be dependent upon the location of the breach in relation to agricultural activities, the lake levels at the time of the breach, and duration of flooding.

Alternative No. 1

Implementation of Alternative No. 1 is anticipated to have moderate impacts on the agriculture along Reach One. Currently, tail-water in the agricultural areas is controlled by local drainage districts and farmers. Under this alternative, these entities would no longer have this control. Culverts with automatic/manual gates and pumps would be installed to control the water level in ditches along Reach One. Water levels could thus be raised as needed to decrease differential head, and increase the stability of the HHD. The overall influence of altered water levels in these ditches is significant if it is perceived as loss of irrigation water by the local farmers.

Alternative No. 2

Implementation of Alternative No. 2 is anticipated to have moderate impacts on the agriculture along Reach One. Installation of a cutoff wall along the length of this Reach could result in reduced tail-waters. The extent of this reduction, if any, is unknown, but any reduction in irrigation waters could adversely affect irrigated crops in this area.

Alternative No. 3

Implementation of Alternative No. 3 is anticipated to cause only minimal impacts to agriculture along Reach One. The perforated culvert system included in the seepage berm design would collect and convey water into existing drainage canals, just as the existing toe ditches have done. No reduction in irrigation water is expected to occur as a result of this alternative.

Alternative No. 4

Implementation of Alternative No. 4 is anticipated to have minimal impacts on the agriculture and agricultural lands along Reach One. Installation of a hanging cutoff wall along the length of this Reach would not affect ground water flow or water table beyond the HHD footprint. The toe ditch with adjacent relief trench and existing conveyance ditches would continue to collect seepage and surface waters and be managed as they are currently. No

reduction in irrigation waters is expected. Land use would not be expected to change as a result of implementing this alternative. The construction of the cutoff wall, access roads, and relief trench are all within the footprint of the existing HHD.

Urban Land

No Action Alternative

In the event of a major failure of the HHD, consequential flooding could have significant effects on urban lands in the area of the failure. The No Action Alternative allows current stability problems of the HHD to persist, which could lead to a major breach of the HHD during a substantial high water event. Loss of life and property in the vicinity of the breach could be substantial if the breach were to occur in a heavily populated area.

Along Reach One, the city of Pahokee is situated along the very toe of the HHD. This city, with a population of nearly 7,000 people, has homes and businesses occupying land immediately adjacent to the HHD. These people and properties are subject to immediate danger if large scale flooding should occur due to dike failure. The city of Belle Glade, with a population of over 16,000 people, is near enough to be influenced by large scale flooding as well. Although the central portion of the city is about one mile (1.6 km) southeast of the HHD, portions of the city occupy land in immediate proximity to the HHD.

Impacts to Pahokee and Belle Glade would be most significant in the event of a high velocity breach associated with a large storm or hurricane event. These consequences may be even greater should a high velocity breach occur during a storm event, at an unseemly hour of the morning, and evacuations do not go as planned.

Selection of the No Action Alternative could result in significant consequences to urban lands within the remaining Reaches around Lake Okeechobee.

Alternative No. 1, 2, 3 & 4

Implementation of any of the alternatives is not expected to result in impacts to the urban lands along Reach One. Construction activities would be limited to the HHD easement and should not affect homes or businesses in this area.

Transportation

No Action Alternative

Major transportation corridors around the perimeter of Lake Okeechobee include several highways and

railroads. If selection of the No Action Alternative and continued levee degradation were to result in a major failure of the HHD, impacts to existing transportation structures would be extensive.

Along Reach One, Highway 98/441, Highway 715, and the Florida East Coast Railroad parallels the HHD for some portion of the Reach (see Section 4.15). In the event of major flooding, the structures nearest the breach could be destroyed. Any travelers or freight moving along these transportation lines would be endangered as well. Even moderate flooding from a low velocity breach is likely to cause road closures and traffic delays.

Alternative No. 1, 2 & 4

Implementation of alternatives no 1, 2, or 4 is anticipated to result in only minimal impacts to the transportation corridors along Reach One. Construction activities are not expected to impact highway or rail structures in the vicinity. Highway traffic can be expected to increase slightly due to movement of construction equipment and personnel, but should result in only minimal impacts.

Alternative No. 3

Implementation of Alternative No. 3 is anticipated to result in only minimal impacts to the transportation corridors along Reach One.

The Florida East Coast Railroad parallels Reach One along the northern half of the Reach and comes within 75 ft (23 m) in places. Although the railroad structure is far enough removed for construction of the seepage berm, railroad drainage ditches and property easements could be encroached.

Highway traffic in the area of Reach One is anticipated to increase slightly due to movement of construction equipment and personnel, but should result in only minimal impacts.

Transmission Lines

No Action Alternative

The No Action Alternative and continued dike stability problems could result in damage to existing electrical transmission lines. A low voltage electric transmission line is situated on the landward slope the HHD in the northern half of Reach One. A dike failure in this area could result in structure damage and power outages down-flow of this event. For this reason, selection of the No Action Alternative could lead to moderate impacts to existing transmission lines and local power lines.

Alternative No. 1, 2, 3 & 4

Implementation of any of the alternatives would result in minor impacts to existing electric transmission lines. Approximately 200 feet of those lines physically located upon the landward slope in the northern and southern most portions of Reach One may require temporary relocation or raising. Construction of the alternatives' features and equipment access may be inhibited by the presence of transmission lines.

Communication

The only significant communication structure in proximity to Reach One is a Florida Highway Patrol communication tower south of the West Palm Beach Canal. This structure is approximately 50 to 75 ft (15 to 23 m) beyond the back toe of the levee.

No Action Alternative

A breach in the HHD could potentially damage this communication tower if it occurred near enough to the structure. Negative implications could be loss of communication between law enforcement officials in this area.

Alternative No. 1, 2, 3, & 4

No impact to the communication tower is expected to result from implementation of Alternatives No. 1, 2, 3 or 4

Limestone Quarries

No Action Alternative and Alternative No. 1, 2 & 4

Implementation of the No Action alternative or Alternatives No. 1, 2 & 4 would cause no significant impact to the limestone quarries in southern portion of Reach One.

Alternative No. 3

Implementation of Alternative No. 3 could potentially cause some alteration to the existing limestone quarries in the southern portion of Reach One. To allow adequate space for construction of the seepage berm in this area, some filling along the western edges of these quarries may be required. Fill material would be stabilized with gabions along the far back toe of the newly constructed berm, precluding the development of a shallow water littoral zone.

As these quarries are no longer being mined, and considering the low practical quality of these quarries as habitat, impacts to this area as a result of implementing Alternative No. 3 would be minimal.

4.16 AESTHETIC RESOURCES

Impacts to aesthetic resources within the project area would be due to construction activities and/or access of construction equipment through lands designated for staging, access and construction. There are no adverse impacts to aesthetic resources due to the no-action alternative. Impacts resultant from the other alternatives considered would be similar. Therefore the discussion below would reference the preferred alternative as a surrogate for impacts associated with construction activities and/or access of construction equipment associated with all action alternatives.

Residents and visitors to Torrey Island would experience temporary construction impacts to the view shed aesthetics while CR 717 near S-351 is used as a construction access point. The construction impacts should return to normal after the project is completed.

The proposed Hooker Highway construction access point off of S.R. 15 would not adversely affect aesthetic resources found in this area.

The proposed Paul Rardin Park construction access point could temporarily affect aesthetic resources in the project area. The heavy equipment access over the park entrance road would temporarily increase noise and dust in the area. The recommended plan's estimated 50 foot wide construction right-of-way would require park vegetation and picnic facilities to be removed from the park property. The tree removal adjacent to the levee toe could expose the park visitor to quarry operations to the south. Stately royal palms that border the entrance road would also be adversely affected due to their proximity to the dike toe. The activities would disrupt the quiet park setting during construction.

The proposed construction access at the Culvert 12A location should not adversely affect aesthetic resources in the area. The access route is screened from adjacent property owners by trees on both sides of the existing road. Some temporary impact to aesthetic resources within the area can be expected during construction. Trees within the 50-foot right-of-way of the levee toe would be removed.

The proposed construction access at the Bacom Point (Culvert 10) area should not affect aesthetics. The proposed access road is through adjacent agricultural fields. Some temporary increase in dust and noise from the heavy equipment can be expected in the project area.

The proposed construction access at Pahokee Marina and Campground (Pahokee State Park) would temporarily disrupt the peaceful park setting. Construction traffic noise would greatly reduce the aesthetic appeal of the lakefront park north and south of the entrance. The view of Lake Okeechobee should not be obstructed by the construction of the recommended plan. Existing vegetation and residential properties along the 50-foot construction right-of-way could be adversely affected in the project area.

The proposed construction access at S-352 off of S.R. 715 would utilize the Canal Point Park entrance road and paved levee crown for construction vehicle access. Some temporary affects during construction could include additional noise, dust, and air pollution. Pre-existing conditions should return once the project has been completed. Exotic vegetation could be affected along the 50-foot construction right-of-way.

The proposed construction access at Culvert 10-A, Culvert 14, and at Port Mayaca off of S.R. 15/700 are in relatively isolated locations with minimal residential development in the area. Temporary construction impacts would not be significant and pre-existing conditions should return once the project has been completed.

4.17 RECREATIONAL RESOURCES

Impacts to recreation resources within the project area would be due to construction activities and/or access of construction equipment through lands designated for staging, access and construction. There are no adverse impacts to recreation resources due to the no-action alternative. Impacts resultant from the alternatives considered, including the preferred alternative, would be similar in scope, magnitude, and duration. Therefore the discussion below will reference the preferred alternative as a surrogate for impacts associated with construction activities and/or access of construction equipment associated with all action alternatives.

Access to construction areas from CR 717 near S-351 would necessitate heavy equipment traversing and working in the area of a public golf course, fishing, camping, boating, sightseeing, and picnicking facilities that are located in the area. Use of these recreation resources is experienced throughout the year. Increased noise and air pollution could be expected during construction activities. Pre-construction conditions would return upon completion of the project construction. No permanent adverse impacts to recreation resources in the project vicinity are expected to occur as a result

of the recommended plan. Projected adverse impacts to the local economy due to a decline in recreation resource use during construction activities is expected to be moderate in magnitude for the duration of the recommended plan construction.

No structured recreation resources exist at the proposed Hooker Highway construction access point off of SR 715. Some temporary impacts to bank fishing use may occur during the construction of the recommended plan. Construction staging areas are projected to interrupt some recreation activities in the area.

Construction activities would significantly impact the Paul Rardin Park. Seasonal park visitor sight-seeing experiences would be adversely affected by increased construction traffic, noise, dust, and air pollution expected during the project. Adverse impacts to or removal of existing park trees and amenities may result due to the recommended plan construction or construction equipment traffic.

No structured recreation resources exist at the proposed Culvert 12A and Culvert 10 construction access point adjacent to SR 715. Some temporary impacts to bank fishing may occur during the recommended plan construction. Construction staging areas would have no impacts to recreation resources in the area.

Construction activities and equipment access may adversely affect the City of Pahokee Marina and Campground (Pahokee State Park) facilities. Park fishing, boat ramp, picnicking, and camping access would be interrupted by the construction vehicle traffic and project construction. Park visitors would experience increased noise, dust, and air pollution during the construction of the recommended plan. Excessive wear of the park's paved roads could occur. The construction project and its traffic would adversely affect many park users. Disruption of recreation resources could pose an adverse impact to the local economy of the City of Pahokee.

The proposed access and construction of the recommended plan near S-352 from SR 715 would interrupt the popular Palm Beach County, Canal Point Park fishing spot. The remnants of the walls and doors of the historical West Palm Beach Canal Lock are a testament to past activity. Local residents fish from the lock walls, banks, and bridge.

The recommended plan construction project and access to the dike crown near Culvert 10A from SR 15/700 would result in some temporary disturbance of local bank fishing in the area.

The access and construction of the recommended plan near Culvert 14 from SR 15/700 could result in temporary restriction of bank fishing in the area. Local residents fish in the area and a secondary trailhead linkage to the Florida National Scenic Trail has been proposed to include access for pedestrians and bicyclists and provide parking for up to five cars (FDOT, 1998). When project construction has been completed, recreation use in the area can be expected to return to pre-construction conditions.

The proposed access and construction of the recommended plan at Port Mayaca (S-308) would adversely affect park visitors during the project construction. Basin bank fishing and dike sightseeing access could be interrupted during project construction. An increase in noise, dust, and air pollution would also be experienced. The Florida National Scenic Trail access would be interrupted during construction. When construction of the recommended plan has been completed, recreation use in the area can be expected to return to pre-construction conditions.

The construction of the recommended plan for the HHD rehabilitation would adversely affect recreation resources in the project area. Most of the construction impacts would result in a temporary disruption due to increased noise, dust and heavy equipment traffic. Other impacts may have a longer lasting affect.

Paul Rardin Park, Pahokee Marina and Campground (Pahokee State Park), and Canal Point Park facilities would be affected the most. Trees, roadway, and picnic shelters may fall within the 50-foot wide construction right-of-way at Paul Rardin Park. Construction equipment travel over the park's entrance road may accelerate maintenance surfacing schedules. Park amenities may require accelerated maintenance schedules.

Pahokee Marina and Campground (Pahokee State Park) may experience accelerated roadway maintenance surfacing schedules. Campground amenities may require accelerated maintenance schedules. Trees may be lost that screen adjacent properties, provide shade or frame views due to compaction, stress, or removal.

Canal Point Park's entrance road may experience an accelerated maintenance-resurfacing schedule due to construction equipment travel. The popular historic locks and lock wall fishing area may fall within the

50-foot wide construction right-of-way, which would permanently deny access.

Some effects to the paved Lake Okeechobee Scenic Trail atop the HHD may occur during project construction. Coordination with FDEP on the Lake Okeechobee Scenic Trail Master plan would be conducted prior and during construction.

4.18 CULTURAL RESOURCES

The HHD (8PB208) is historically significant and may be eligible for inclusion on the National Register of Historic Places (NRHP). All alternatives, including the No Action Alternative, would have an effect on the historic significance of the HHD. However, the Corps has determined in accordance with the National Historic Preservation Act of 1966, as amended (NHPA), that Alternatives 1, 2, 3 or 4 would cause minimal impacts on the HHD. A number of historic structures and significant archaeological resources are located near the HHD; however, none are within the HHD's right-of-way. The No Action Alternative, with its continued potential for dike failure and catastrophic flooding, would have moderate to extensive consequences on the HHD and nearby historic properties. Alternatives 1, 2, 3 and 4 would cause minimal to moderate short-term impacts on the cultural resources, if implemented.

4.19 SOCIOECONOMICS

No Action Alternative

If the No Action Alternative is selected, there could be significant socioeconomic implications, as it could allow for continued degradation of the HHD's stability leading to a breach of the HHD. The potential for loss of life and property from a breach is significant to residents along the HHD as well as those that utilize the HHD for recreation. This alternative does not provide adequate protection from the seepage and stability problems that threaten critical areas of Reach One of the HHD. Human well being and safety, as well as property could be severely impacted in the event of a levee breach between the Hillsboro and West Palm Beach Canals especially as there is significant urban and residential development very close to the HHD in this area.

Alternatives No. 1, 2, 3& 4

It is not anticipated that there would be any long-term socioeconomic impacts as a result of implementing Alternatives 1, 2, 3 or 4. Indeed, the positive monetary benefits realized by those firms and persons involved with construction of the project may offset any short-term negative impacts that might be

experienced. Potential negative implications of the construction phase could include some short-term impacts on traffic and tourism. However, this would be dependent on the size of the construction workforce residing in the area, and the timing of the construction process (for example, whether during peak tourism season). As the continued operation/maintenance of the preferred Alternative is not expected to require the relocation of a significant number of individuals to the local study area, no socioeconomic impacts are anticipated during the operation/maintenance phase of the project.

Construction and ongoing operation/maintenance of either of the first three Alternatives would generate positive economic impacts for the local region, and the state of Florida as a whole. Directly, the construction and any ongoing operation/maintenance of the project would have a positive impact on employment, labor income, gross domestic product and government revenues. The effect on these variables would be even higher once the impacts resulting from the procurement of goods and services and the spending of additional labor income are taken into account (the indirect and induced effects of the capital spending).

Labor would be required to design/engineer the project and to actually construct it. Construction of the preferred alternative would also require tradespersons with a variety of skills. It is anticipated that most of the construction employment would be filled by individuals residing in the local study area; however, some may come from other regions of Florida. The direct project employment only represents the direct employment impact in the local region. It does not include the indirect or induced employment that would be generated in the local study area, and the State of Florida, as a result of the project. Not all the employment is confined to the construction industry, as the project would create significant employment opportunities in other industries as well. Industries likely to see the largest boost in employment are community, business, personal services, manufacturing and retail trade.

In addition to the impact on employment, the construction and operation/maintenance of the preferred alternative would have a positive impact on Florida's gross domestic product. Another important economic benefit for the local study area and the state of Florida as a whole would be an increase in labor incomes.

In addition to private sector and individual households, county, state and Federal governments

would benefit from the construction and operation/maintenance of the proposed alternative through higher revenues. These higher revenues would come about through a number of avenues including personal income taxes, employee and employer contributions to unemployment insurance plans, and other indirect taxes on goods and services that may be purchased.

4.21 CUMULATIVE EFFECTS

Foreseeable actions that may affect the Lake Okeechobee region in ways similar to that of the proposed improvements along Reach One, are improvements of similar nature along one or more of the remaining reaches. Considering that each reach delineates a separate watershed, landward impacts to existing environmental conditions should be separate and not cumulative. Waterward impacts of implementing an improvement alternative have no significant negative impacts per individual reach, and should not if additional improvements are conducted. In fact, the cumulative impacts of further improvements stand to be positive rather than negative, increasing the stability and safety of the HHD system, and enhancing water resource capabilities to meet all existing needs.

4.22 UNAVOIDABLE ADVERSE EFFECTS

As discussed under each resource element in Section 4.0, the negative impacts associated with implementing the preferred alternative action would not be significant. Unavoidable adverse effects that would result from implementation of this alternative are expected to be minimal to moderate in severity. A summary of unavoidable negative impacts follows.

Topography, Geology and Soils

No significant adverse impacts to the topography, geology, and soils are likely to occur due to implementation of the preferred alternative. Minimal impacts to soils as a result of excavation and filling is expected.

Water Resources

Minimal adverse impacts to the hydrology, water supply, water quality and water management are expected to occur as a result of implementing the preferred alternative.

Vegetation and Cover Types

No significant adverse impacts to the vegetation and cover types are likely to occur due to implementation of the preferred alternative. Minimal short-term impacts to vegetation as a result of construction and minor excavation for this alternative are expected.

Minimal effects would occur only within the HHD footprint.

Wetlands

The preferred alternative minimizes impacts to wetlands by constructing outside of the toe ditch footprint on the HHD slope maintaining an open conveyance system, and employing erosion and turbidity controls during and after the construction. Negative consequences should be minimal.

Fish and Wildlife

Minimal adverse effects to fish and wildlife are likely to occur due to implementation of the preferred alternative. The foraging habitat for wading birds in the landward toe ditches would not be altered through implementation of this alternative. Additionally, existing reptiles, amphibians, and fishes utilizing these ditches could continue to use the toe ditch, although they may be temporarily displaced during construction.

Threatened and Endangered Species

Minimal adverse impacts to threatened and endangered species are likely to occur due to implementation of the preferred alternative. The foraging habitat for listed wading birds (e.g. wood storks, tri-colored heron, little blue heron) in the landward remnant wetlands would be temporarily impacted during construction. However, the toe ditch and remnant wetlands would remain an open system that could be used by these species. Surveys and management measures for certain species would be conducted or followed prior to construction to minimize impacts, as well as erosion and turbidity measures employed during construction. See Section 5 for details.

Noise

Minor localized noise related impacts during construction operations are expected to occur due to implementation of the preferred alternative.

Air Quality

Minor and localized air quality impacts during construction operations is expected to occur due to implementation of the preferred alternative.

Land Use

Temporary relocation of electrical transmission lines may be required to conduct construction activities listed with this alternative.

Aesthetic Resources

Limited, short-term adverse impacts associated with construction activities would be imposed on aesthetic resources within the project area. These impacts may be mitigated by implementation of a well planned aesthetic measures plan which would account for unavoidable tree and native vegetation removal and dust from earth moving equipment among others. These impacts would be expected to be temporarily adverse at or near to parks, natural areas, residential or urban areas.

Recreation Resources

Limited, short-term adverse impacts associated with construction activities would be imposed on recreation resources within the project area. These impacts may be mitigated by implementation of a well planned recreation measures plan which would account for the cost of pavement resurfacing at parks and other areas used for staging and equipment access, tree replacement, and park amenity replacement, rehabilitation, or repair. An inventory of park amenities and utilities prior to construction would facilitate a rapid return to pre-construction state for those areas so impacted.

4.23 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

As discussed under each resource element in Section 4.0, the negative impacts (short-term uses) associated with implementing a selected alternative action would not be significant.

The environmental impacts of this effort are insignificant in terms of the human environment, and the costs to the natural environment. In fact, a positive net benefit to human safety and environmental quality both locally and regionally is expected to result from implementation of Alternative Nos. 1, 2, 3 or 4.

4.24 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

Significant Federal funding would be irretrievably expended during the implementation of Alternative Nos. 1, 2, 3 or 4. In terms of natural resources, impacts are small and limited to HHD footprint. Environmental resources are expected to rebound to pre-construction conditions.

TABLE 4
SUMMARY OF ENVIRONMENTAL CONSEQUENCES
 (Page 1 of 3)

Environmental Components	No Action Alternative	Alternative No. 1	Alternative No. 2	Alternative No. 3	Alternative No. 4
Location & Climate	No Consequences Expected (0)	No Consequences Expected (0)	No Consequences Expected (0)	No Consequences Expected (0)	No Consequences Expected (0)
Topography	No Consequences Expected (0)	No Consequences Expected (0)	No Consequences Expected (0)	No Consequences Expected (0)	No Consequences Expected (0)
Geology	No Consequences Expected (0)	No Consequences Expected (0)	No Consequences Expected (0)	No Consequences Expected (0)	No Consequences Expected (0)
Soils	Potential for displacement of soils nearest dike failure (3)	Displacement of soils during excavation of peat in toe ditch (1)	Displacement of levee soils for cutoff wall, & peat during excavation of toe ditch (1)	Displacement of soils during excavation of toe ditch (1)	Displacement of levee soils for cut-off wall and relief trench (1)
Hydrology	Flooding may affect existing evaporation and recharge regime(3)	Elevated water level in toe ditches may result in localized flooding (2)	Cutoff wall may lower water table and recharge rates (2)	Perforated culverts in relief trench should not lower recharge rates (1)	Hanging cutoff wall reduces hydrology only in HHD footprint. (1) Minimal effects to water table or recharge rates.
Water Supply	Reduced ag. water supply at critical times may damage crops (2)	Loss of tail-water control by private interests may cause conflict (2)	Cutoff wall may reduce tail-waters and ag. water supply (2)	Water Supply not significantly affected (1)	Alternative would not significantly affect water supply.
Water Quality	Increased sediments in surface waters due to flooding (2)	Erosion control efforts during construction should minimize impacts (1)	Erosion control efforts during construction should minimize impacts (1)	Erosion control efforts during construction should minimize impacts (1)	Erosion control efforts during construction should minimize impacts (1)
Water Management	Short-term alteration of current water management practices likely (2)	Loss of tail-water control by private interests may cause conflict (2)	Current water management practices not significantly affected (1)	Current water management practices not significantly affected (1)	Current water management practices not significantly affected (1)

0 = No Consequences 1 = Minimal Consequences 2 = Moderate Consequences 3 = Extensive Consequences

TABLE 4
SUMMARY OF ENVIRONMENTAL CONSEQUENCES
 (Page 2 of 3)

Environmental Components	No Action Alternative	Alternative No. 1	Alternative No. 2	Alternative No. 3	Alternative No. 4
Vegetation & Cover Types	Native vegetation and crops could be damaged by floodwaters (3)	Impacts limited to vegetation along levee and in/around toe ditches (1)	Impacts limited to vegetation along levee and in/around toe ditches (1)	Impacts limited to vegetation along levee and in/around toe ditches (1)	Impacts limited to vegetation along levee in HHD footprint (1)
Wetlands	Significant wetland impacts not expected (1)	Significant wetland impacts not expected (1)	Cutoff wall may reduce water supply to landward wetlands nearest HHD (2)	Some wetlands would be converted to covered culverts (2). Mitigation would be required.	Hanging cutoff wall allows seepage under HHD. Water supply to toe ditch wetlands should remain unaffected (1)
Fish & Wildlife	Loss of some wildlife habitat in vicinity of breach (2)	Periodic increase of landward waters may alter some wildlife habitat (1)	Cutoff wall may reduce water supply altering wildlife habitat (2)	Covered culverts would eliminate some foraging habitat along existing toe (2)	Habitat provided by toe ditch would not be eliminated or converted to closed conduit since relief trench adjacent to ditch (1)
Threatened & Endangered Species	No significant impacts to T & E species expected (1)	No significant impacts to T & E species expected (1)	No significant impacts to T & E species expected (1)	No significant impacts to T & E species expected (1)	No significant impacts to T & E species expected (1)
Noise	No Consequences Expected (0)	Minimal, temporary, and localized effects due to construction activities (1)	Minimal, temporary, and localized effects due to construction activities (1)	Minimal, temporary, and localized effects due to construction activities (1)	Minimal, temporary, and localized effects due to construction activities (1)
Air Quality	No Consequences Expected (0)	Minimal, temporary, and localized effects due to construction activities (1)	Minimal, temporary, and localized effects due to construction activities (1)	Minimal, temporary, and localized effects due to construction activities (1)	Minimal, temporary, and localized effects due to construction activities (1)
HTRW	No Consequences Expected (0)	No Consequences Expected (0)	No Consequences Expected (0)	No Consequences Expected (0)	No Consequences Expected (0)
Land Use Agriculture	Extensive crop damage possible (3)	Loss of tail-water control by private interests may cause conflict (2)	Cutoff wall may reduce water supply producing localized affects to agriculture (2)	No significant impacts to agriculture is expected (1)	No significant impacts to agriculture is expected (1)

0 = No Consequences 1 = Minimal Consequences 2 = Moderate Consequences 3 = Extensive Consequences

TABLE 4
SUMMARY OF ENVIRONMENTAL CONSEQUENCES
 (Page 3 of 3)

Environmental Components	No Action Alternative	Alternative No. 1	Alternative No. 2	Alternative No. 3	Alternative No. 4
Land Use	Loss of property and life possible in worst case scenario (3)	No significant impacts to urban Land Use expected (1)	No significant impacts to urban Land Use expected (1)	No significant impacts to urban Land Use expected (1)	No significant impacts to urban Land Use expected (1)
Land Use Transportation	Flooding may damage roads and railroads (3)	No significant impacts to trans. Features expected (1)	No significant impacts to trans. features expected (1)	Seepage berm may extend into Railroad easement. (1)	No significant impacts to trans. features expected (1)
Land Use Transmission Lines	Flooding may damage transmission line structures, resulting in power outages (2)	Construction activities may necessitate temporary relocation of transmission lines (1)	Construction activities may necessitate temporary relocation of transmission lines (1)	Construction activities may necessitate temporary relocation of transmission lines (1)	Construction activities may necessitate temporary relocation of transmission lines (1)
Aesthetic Resources	No consequences expected (0)	Temporary/Short-term impacts to localized areas as a result of construction. Possible vegetation & tree removal (1)	Temporary/Short-term impacts to localized areas as a result of construction. Possible vegetation & tree removal (1)	Temporary/Short-term impacts to localized areas as a result of construction. Possible vegetation & tree removal (1)	Temporary/Short-term impacts to localized areas as a result of construction. Possible vegetation & tree removal (1)
Recreational Resources	No consequences expected (0)	Temporary/Short-term impacts to parks, bank fishing, bike trail, access to select lake side locations as a result of construction (1)	More severe impacts to recreation as a result of construction on lakeside face of levee. Possible lake access restrictions, bank fishing, bike trail impacts (2)	Temporary/Short-term impacts to parks, bank fishing, bike trail, access to select lake side locations as a result of construction (1)	Temporary/Short-term impacts to parks, bank fishing, bike trail, access to select lake side locations as a result of construction (1)
Cultural Resources	Potential significant adverse effects in event of dike failure (2)	Minimal, non-adverse effects (1)	adverse effects (1) Minimal, non-adverse effects (1)	Minimal, non-adverse effects (1)	Minimal, non-adverse effects (1)
Socioeconomics	Flooding may result in loss of property and life (3)	No adverse consequences expected. Possible beneficial impacts to local economy due to construction (0)	No adverse consequences expected. Possible beneficial impacts to local economy due to construction (0)	No adverse consequences expected. Possible beneficial impacts to local economy due to construction (0)	No adverse consequences expected. Possible beneficial impacts to local economy due to construction (0)
0 = No Consequences		1 = Minimal Consequences	2 = Moderate Consequences	3 = Extensive Consequences	

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5.0 ENVIRONMENTAL COMMITMENTS

The U.S. Army Corps of Engineers and contractors commit to avoiding, minimizing or mitigating for adverse effects during construction activities by including the following commitments in the contract specifications:

(1) The Corps shall conduct a pre-construction survey to determine actual locations of bald eagle nests within the immediate vicinity of Reach One prior to issuance of any construction contracts. Results shall be coordinated with the USFWS, Vero Beach office.

(2) Standard protection measures regarding the Eastern indigo snake shall be included in the environmental protection plan when the Corps proceeds to the plans and specifications phase for this project.

(3) The Corps shall conduct a survey for burrowing owls commensurate with that for bald eagle nests prior to issuance of any construction permits. The Corps shall consult with the FFWCC regarding adopting standardized protection measures should any owls be identified within Reach One. Results shall be coordinated with the USFWS and FFWCC.

If burrowing owls are found to be present in the project area, impacts shall be minimized by altering construction schedules to avoid the nesting season and/or burrows shall be cordoned off to avoid their direct destruction.

(4) Continued recreation planning shall be performed during detailed project engineering and design. In

addition, the appropriate FDEP representative shall be contacted to insure collaboration on design features with the Scenic Trail Master Plan Coordination. An inventory of park amenities and utilities prior to construction would facilitate a rapid return to pre-construction state for those areas so impacted. Implementation of a well planned recreation plan that would account for the cost of pavement resurfacing at parks and other areas used for staging and equipment access, tree replacement, and park amenity replacement, rehabilitation, or repair

(5) Construction crews shall be made aware of the potential for the presence of the Okeechobee gourd. If the gourd is found, the Service shall be notified.

(6) The project will require a water quality certification under Chapter 373, F.S. and Section 402 of the Clean Water Act .

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6.00 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

The alternative plans were considered in relation to compliance with Federal environmental review and consultation requirements.

6.01 NATIONAL ENVIRONMENTAL POLICY ACT of 1969, as amended

Scoping for the Herbert Hoover Dike Major Rehabilitation Evaluation Report was initiated in December 1994. A Notice of Intent to prepare the draft Environmental Impact Statement was published in the Federal Register on September 30, 1996 (Volume 61, Number 190). Environmental information on the project has been compiled and the Draft Environmental Impact Statement for the Herbert Hoover Dike Major Rehabilitation Evaluation Report was noticed in the Federal Register on August 6, 1999 (Volume 64, Number 151)], and circulated for public and agency review and comment. A systematic interdisciplinary approach to planning has been utilized; alternatives have been studied, developed and described, and ecological information has been developed and utilized. The Supplemental Draft EIS has been prepared to analyze the alternatives, including a new alternative developed through VE and emergency operations evaluation. It is anticipated to be noticed and circulated for agency and public comment in spring of 2005.

6.02 FISH AND WILDLIFE COORDINATION ACT of 1958, as amended

In response to the requirements of this Act, the Corps has and will continue to maintain continuous coordination with the U.S. Fish and Wildlife Service (USFWS) and the Florida Fish and Wildlife Conservation Commission (FFWCC) during all stages of the planning and implementation of this project. On October 30, 1998 the USFWS submitted a draft Fish and Wildlife Coordination Act Report (CAR) for this study. This report had been coordinated with the state agency responsible for the management of game and fish, the FFWCC. The findings and recommendations in the draft CAR have received concurrence from the FFWCC in a letter dated November 12, 1998. The December 20, 2001 CAR is presented in Annex A.

The USFWS principal concern as presented in the draft CAR is to avoid environmental impacts to the lake itself, including avoidance of disposal of fill material or armoring of shoreline on the lake side of the HHD. A secondary concern is the potential for erosion of soils and associated nutrients into the lake from construction activities on the lake side face of the levee. This impact is largely alleviated since all

construction activities, it is understood, will occur on the landward side of the levee. A third concern is the indirect impact of disturbance, due to construction activities, on significant fish and wildlife resources, including Federal and state listed species e.g. the bald eagle, Eastern indigo snake, and the burrowing owl. Mitigation measures and standard protection measures for the endangered species will be included as project construction conditions.

The USFWS submitted a final CAR on December 20, 2001 supporting a mitigation plan proposed for impacts associated with implementing Alternative No. 3., with conditions to the project and recommendations. The USFWS was again consulted after the preparation of the VE Study completed in July 2002, which recommended a modification to the design of the recommended plan. The USFWS responded by letter dated March 4, 2003, concluding that based on the avoidance of impacts, no mitigation would be required. However, the VE study has been demonstrated to only be effective in certain areas as designed, and therefore proposed only in Sub-Reach 1A. In February 2004, the USACOE coordinated the 30% detailed design document with USFWS that proposed a revised alternative for Reach 1. Coordination addressed specifically the concerns in sub-reach 1A, where the higher quality wetlands were identified and impacts to such were a concern. This design in fact is proposed for use throughout all Reach 1, and is the preferred alternative (No. 4) of this EIS. The USFWS responded to the new alternative for sub-reach 1A in a supplemental CAR stating no significant impacts are expected to fish and wildlife resources. Wetland mitigation is not considered a requirement for Reach 1 construction. However, coordination with USFWS will continue as design and planning is undertaken. Correspondence is included in Annex A. This project is in full compliance with the Act.

6.03 ENDANGERED SPECIES ACT of 1973, as amended

Consultation was initiated with NMFS on December 6, 1994, and completed on September 16, 1999, with the NMFS concurrence on the determination of not likely to affect species under NMFS purview.

Consultation was initiated with USFWS on September 1, 1995. A determination that the recommended plan was not likely to adversely affect

Federal and state listed species was made by the Corps and sent to USFWS in a letter dated November 30, 1998. The USFWS concurred with this determination in a letter dated June 9, 1999. After reviewing proposed design modification addressed in the VE report of 1999, the design of which would be used in Sub-Reach 1A, the USFWS again concurred with the determination of no affect in a letter dated March 4, 2003. This project has been and will continue to be coordinated under the Endangered Species Act throughout the design phase and construction. As the project moves into subsequent planning phases continued coordination will be undertaken to ensure that those recommendations mutually agreed upon between the USFWS and the Corps are carried out. This project is in full compliance with the Act.

6.04 NATIONAL HISTORIC PRESERVATION ACT of 1966, as amended

The study is in full compliance with this Act. Consultation with the Florida SHPO has been completed. The SHPO has concurred with the Corps determination of no adverse effect by letter dated August 14, 1998. Cultural resources investigations are ongoing along other Reaches of the HHD to determine effects to historic properties. When completed, results will be coordinated with the SHPO and the Advisory Council on Historic Preservation.

6.05 CLEAN WATER ACT of 1972, as amended

The study is in partial compliance at this stage. Full compliance will be achieved with issuance of Water Quality Certification under Section 401 from the State of Florida. A Section 404(b)(1) Evaluation is included in this report as Annex C.

6.06 CLEAN AIR ACT of 1972, as amended

This project has been coordinated with the Florida Department of Environmental Protection, Air Quality Division, and the U.S. Environmental Protection Agency (EPA) in compliance with Section 309 of the Act. The review findings of the EPA on the Draft EIS were published in the Federal Register of October 8, 1999.

EPA expressed concern regarding impacts to recreation/infrastructure features, erosion control and loss of project effectiveness during heavy rain/or backpumping. EPA requested that these issues be addressed in the final document. Responses have been prepared and are provided in the Annex E, Comments and Responses to the Draft EIS.

No air quality permits would be required for this project. Coordination with the EPA will be ongoing as detailed design information becomes available.

6.07 COASTAL ZONE MANAGEMENT ACT of 1972, as amended

A federal consistency determination in accordance with 15 CFR 930 Subpart C is included in this report as Appendix D. State consistency review was performed during the coordination of the draft EIS and the State has determined that, at this stage, the project is consistent with the Florida Coastal Zone Management Program.

6.08 FARMLAND PROTECTION POLICY ACT of 1981

The study is in full compliance. No farmland would be affected in the study area.

6.09 WILD AND SCENIC RIVER ACT of 1968, as amended

The study is in full compliance. No rivers designated under the Act are in the study area.

6.10 ESTUARY PROTECTION ACT of 1968

The study is in full compliance. No estuaries under the Act are in the study area.

6.11 FEDERAL WATER PROJECT RECREATION ACT of 1965, as amended

The project is in full compliance at this stage. The effects of the proposed action on outdoor recreation have been considered and are presented in the Draft and Supplemental Draft EIS. Continued recreation planning will be performed during detailed project engineering and design.

6.12 RESOURCE CONSERVATION AND RECOVERY ACT of 1976

This law has been determined to be not applicable, as there are no items regulated under this act either being disposed of or affected by this project.

6.13 TOXIC SUBSTANCES CONTROL ACT of 1976

This law has been determined to be not applicable, as there are no items regulated under this act either being disposed of or affected by this project.

6.14 MARINE PROTECTION, RESEARCH, AND SANCTUARIES ACT of 1972, as amended

This Act is not applicable. Ocean disposal of dredged material is not proposed as a part of the HHD Major Rehabilitation Evaluation Feasibility Report.

**6.15 RIVERS AND HARBORS
APPROPRIATION ACT of 1899**

The study is in full compliance. The proposed work would not obstruct navigable waters of the United States.

**6.16 COASTAL BARRIER RESOURCES
ACT**

This Act is not applicable. The study area is not in a designated Coastal Barrier Resources Act unit.

**6.17 Section 904 of the 1986 WATER
RESOURCES DEVELOPMENT ACT**

Section 904 of the 1986 Water Resources Development Act requires that the plan formulation and evaluation process considered both quantifiable and unquantifiable benefits and costs of the quality of the total environment, and preservation of cultural and historical values. The study and report are in full compliance.

**6.18 Section 307 of the 1990 Water Resources
Development Act**

Section 307 of the 1990 Water Resources Development Act establishes, as part of the water resources development program, an interim goal of no overall net loss of the Nation's remaining wetlands, and a long-term goal of increasing the quality and quantity of the Nation's wetlands. The recommended plan is in compliance. Several acres of remnant, poor quality wetlands are likely to be effected. Avoidance of higher quality wetlands and mitigation for effected wetland acreage will ensure there is no net loss of wetland function.

**6.19 E.O. 11988, FLOODPLAIN
MANAGEMENT**

The study is in compliance. While the considered alternatives have no impact on avoidance of development in the flood plain, the recommended plan would directly support a reduction in hazards and risks associated with floods and would minimize the impact of floods on human safety, health and

welfare. The recommended plan would have no impact on the restoration and preservation of the natural and beneficial values of the base flood plain.

**6.20 E.O. 11990, PROTECTION OF
WETLANDS**

The study is in compliance. The nature of the recommended plan avoids filling the landward toe ditch, a man-made, yet functional wetland of moderate to poor functional value and maintains construction of permanent features to the lakeward toe of the dike.

**6.21 E.O. 12114, ENVIRONMENTAL
EFFECTS ABROAD OF MAJOR FEDERAL
ACTIONS**

This executive order is not applicable to this study. The study area does not include lands outside the United States.

**6.22 E.O. 12898, ENVIRONMENTAL
JUSTICE**

Executive Order 12898 requires the Federal government to review the effects of their programs and actions on minorities and low income communities. The Recommended Plan that was formulated for the Herbert Hoover Dike would help to ensure the safety of those communities within the study area (e.g. Belle Glade and Pahokee) as well as residents living within the area anticipated to be impacted in the event of a project failure. In addition to ensuring the safety and well being of residents and their property, implementation of the recommended plan may have a significant beneficial effect on local communities through job creation, increased sale of construction material and other goods necessary to sustain a large construction force for the duration of the project. The study area is known to contain an important percentage of low income and minority individuals. This project is not expected to have disproportionately high and adverse human health or environmental impacts on minority or low-income populations.

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7.00 LIST OF PREPARERS

The people who were responsible for contributing to the preparation, review and technical editing of this Draft and Supplemental Draft EIS are listed in Table 6.

**TABLE 5
SUPPLEMENTAL DRAFT
ENVIRONMENTAL IMPACT STATEMENT
LIST OF PREPARERS**

Name	Affiliation	Discipline/Expertise	Role in Preparing Document
Daphne Ross	US Army Corps of Engineers	Project Management	Project Management;
Paul C. Stevenson	US Army Corps of Engineers	Landscape Architect	SDEIS Preparation; Aesthetics/Recreation
Rebecca J. Weiss	US Army Corps of Engineers	Biologist	SDEIS Preparation, Environmental Compliance; Executive Summary
Tracy Hendren	US Army Corps of Engineers	Geotechnical Engineer	SDEIS Alternative Design Modification
Olice Carter	US Army Corps of Engineers	Environmental Engineer	Preparation of Responses to DEIS - 1999
Jacob Davis	US Army Corps of Engineers	Geotechnical Engineer	Preparation of Supplemental MRR

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8.00 PUBLIC COORDINATION

8.01 SCOPING AND DRAFT EIS

A Notice of Intent to prepare a Draft Environmental Impact Statement for the HHD MRR was published in the Federal Register Volume 61, No. 190 on September 30, 1996. A Scoping Letter describing the proposed project and soliciting comments was sent to government agencies, non-governmental agencies, Indian Tribes and the interested public on December 6, 1994. Written responses to the Scoping Letter were submitted to the Corps and served to assist in identifying potential environmental and planning issues throughout the study. A copy of the Scoping Letter and written responses are on file at the U.S. Army Corps of Engineers, Jacksonville District.

The Notice of Availability (NOA) of the Draft EIS appeared in the Federal Register on August 6, 1999. In addition, the NOA was mailed to interested and affected parties by letter dated July 21, 1999. Comments received and responses to those comments

have been incorporated into the Supplemental Draft EIS as added as Annex E.

8.02 COMMENTS RECEIVED AND RESPONSES

Several comments were received in response to the Draft EIS. Table 6 summarizes the comments. A full description of comments and Corps responses to address any issues are included in Annex E.

8.03 CIRCULATION OF SUPPLEMENTAL DRAFT EIS

Copies of the Supplemental Draft EIS will be mailed to appropriate Federal and State agencies, as well as all commenters on the draft EIS. Additional copies of the Supplemental Draft EIS will be made available to any requesting parties. The Supplemental Draft EIS will also be posted electronically at <http://www.saj.usace.army.mil/pd/envdocs/envdocsb.htm>.

TABLE 6
MATRIX OF DRAFT EIS COMMENTS ON
HERBERT HOOVER DIKE MRR
JULY 1999 – MARCH 2003

SOURCE OF LETTER	SIGNIFICANT ISSUES	NOTE
City of Pahokee Mr. Kenneth N. Schenck, City Manager	Potential City water plant impacts concerns and adjacent toe ditch obstacles	Concerns are addressed in the HHD MRR VE Study, July 2002, recommended plan
Southwest Regional Planning Council Mr. Wayne E. Daltry, Executive Director	The HHD MRR Reach One found Regionally Significant & Consistent with SWRPC goals, objectives and policies	No further action required
National Marine Fisheries Service Mr. Charles Oravetz, Assistant Regional Administrator Protected Resources Division	Downstream water quality concerns that may affect endangered Johnson's seagrass in St. Lucie Estuary	Proposed project would take place in area not within NMFS purview.
Environmental Protection Agency Heinz J. Mueller, Chief Office of Environmental Assessment	Environmental ramifications minimized, further plan refinement needed to improve project further	Additional courtesy coordination will be done as detailed design information becomes available
South Florida Regional Planning Council	The HHD MRR Reach One found consistent with SFRPC goals,	No further action required

Mr. John E. Hulsey, AICP, Senior Planner	objectives and policies	
National Marine Fisheries Service Mr. Charles Oravetz, Asst Reg Adm Protected Resources Division	None – Best Management Practices for water quality will suffice	No further coordination with NMFS needed unless plans change.
Department of the Interior Mr. James Lee Regional Environmental Officer	Exotics in collector canals, WRAP assessment needed for toe ditches, toe ditch impact compensation, wet-land value consistency thru out EIS	DOI issues will be worked out with USFWS
South Florida Water Mgmt District Mr. Lewis Hornung, Project Manager	A combination of 3 alternatives should be considered. 2 pgs of staff specific comments were provided	A combination of alternatives would be implemented based on the HHD MRR and the July 2002 VE study. The DEIS will be edited per staff cmts.
Department of Community Affairs Mr. Ralph Cantral, Executive Director Florida Coastal Management Program	The Florida State Clearing House has coordinated a review of the referenced project.	No adverse effects are anticipated with the implementation of Alternative 3.
Florida Department of Transportation	FDOT noted the project may impact the Lake Okeechobee Segment of the Florida National Scenic Trail,	FDOT requests access to the HHD via proposed trailheads not be restricted.
Florida Department of State Division of Historical Resources	FDOS noted HHD is eligible for listing the National Register of Historic Places	The HHD would need to be documented as per HAB standards prior to constructional.
Florida Department of Environmental Protection	FDEP noted that Alt. 3 is the environmentally preferred alternative	A FDEP WQC will be required
United State Fish & /Wildlife Service Vero Beach Office	Based on review of HHD MRR RCH 1 Value Engineering Study, July 02, and further consultation for mitigation, further consultation is not required at this time. BMPs, protection measures for nesting Bald Eagles and the Eastern Indigo Snake, and wetland mitigation are required.	Protection measures have been coordinated with Engineering Division and the Corps' contractor for the nesting bald eagle and eastern indigo snake. Clearing and planting of mitigation site has been initiated. No further action required at this time.

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10.0 LIST OF RECIPIENTS

FEDERAL AGENCIES

Bureau of Indian Affairs
Everglades National Park
Federal Emergency Management Administration
Federal Highway Administration
National Marine Fisheries Service
National Park Service
U.S. Environmental Protection Agency, Region 4
U.S. Army Corps of Engineers
U.S. Department of Agriculture
U.S. Department of Energy
U.S. Department of Housing and Urban Development
U.S. Department of the Interior
U.S. Department of Justice
U.S. Fish and Wildlife Service

STATE AGENCIES

Department of Agriculture and Consumer Services
Florida Department of Agriculture
Florida Department of Environmental Protection
Florida Department of Transportation
Florida Fish and Wildlife Conservation Commission
Florida Power & Light
South Florida Water Management District

ASSOCIATIONS

1000 Friends of Florida
Audubon Society of the Everglades
Caloosahatchee River Citizens Assoc.
Defenders of Wildlife
FADE
Florida Audubon Society
Florida Sportsmen Conservation Association
Florida Wildlife Federation
Friends of Lake Okeechobee
Friends of the Everglades
Izaak Walton League
Lake Region Audubon Society
League of Women Voters, Broward
National Audubon Society
National Parks and Conservation Association
National Resources Def. Council
National Wildlife Federation
Ridge Audubon Society
Save the Manatee
Sierra Club, Loxahatchee
St. Lucie River Initiative
The Arthur R. Marshall Foundation and Florida
Environmental Institute, Inc.
The Florida Biodiversity Project

The Nature Conservancy
The Wilderness Society
Tropical Audubon Society, Inc.
Trust for Public Lands
World Wildlife Fund

NATIVE AMERICAN TRIBES

Miccosukee Tribe of Indians
Seminole Tribe of Florida

FLORIDA LEGISLATIVE OFFICES

Governmental Responsibility Council
House Environmental Protection Committee
Legislative Library

AGRICULTURE INTERESTS

Dairy Farmers Inc.
Drake Ranch
Florida Cattleman's Association
Florida Citrus Mutual
Florida Sugar Cane League, Inc.
Flo-Sun, Inc.
Frierson Farm
Gulf Citrus Growers
Indian River Citrus League
Landers & Parsons
Lewis Friend Farms, Inc.
MacVicar, Frederico & Lamb, Inc.
McArthur Farm
South Florida Agricultural Council
Stitt Ranch Inc
Sugar Cane Growers Cooperative
United States Sugar Corp.

COUNTIES

Glades County Administration
Hendry County Administration
Martin County Administration
Metro-Dade Center, Office of the City Manager
Miami Dade County
Okeechobee County Administration
Osceola County Administration
Palm Beach County Administration
Polk County Administration
St. Lucie County Administration

COUNTY LIBRARIES

Barron Library
Belle Glade Branch Public Library
Clewiston Public Library
Glades County Public Library
Hendry County Library System
Highlands County Library System
Luola V. York Library
Martin County Library System
Okeechobee County Library
Osceola County Library System
Palm Beach County Library System
South Bay Public Library
St. Lucie County Library System

OTHER PUBLIC

Belle Glade Chamber of Commerce
Bill Mathis
City of Pahokee
LBFH Inc.
Marine Industries Association of Florida, Inc.
Mr. and Mrs. Clayton Diebel
Mr. Jack Moler
Mr. John Geddie
Okeechobee Waterway Association
Pahokee Chamber of Commerce
Pahokee Marina

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